THE RESULTS OF THREE TYPES OF DRILL WORK IN ARITHMETIC.

By

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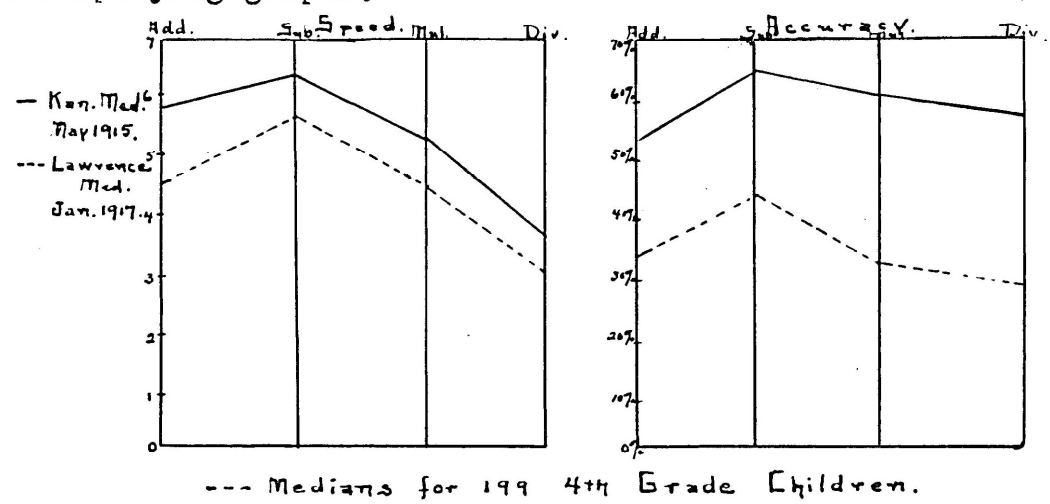
C O N T E N T S.

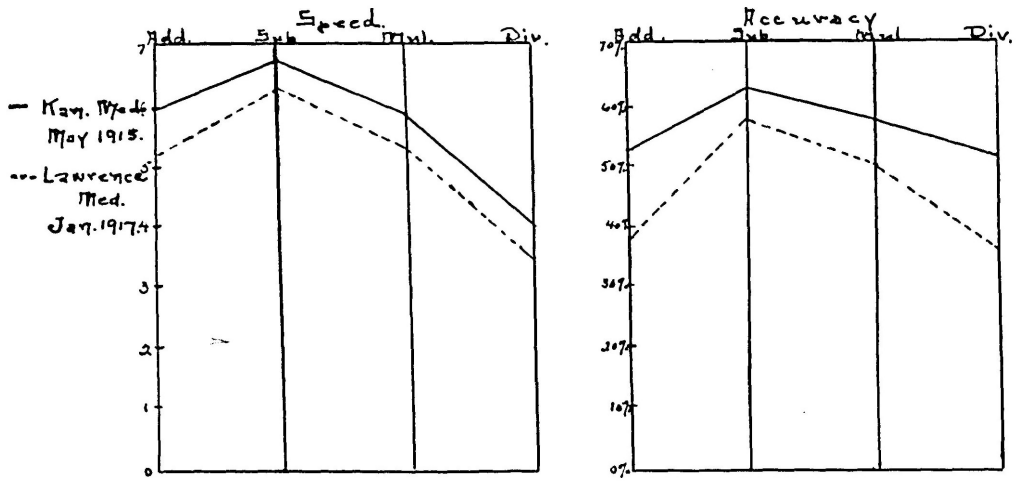
	Page
Introduction	1
Previous Investigations	12
PART I.	
INTERMEDIATE GRADES	
Chapter I. Fourth Grade Results	15
Chapter II. Fifth Grade Results	27
Chapter III. Sixth Grade Results	43
PART II.	
JUNIOR HIGH SCHOOL	
Chapter I. Seventh Grade Results	56
Chapter II. Eighth Grade Results	71
PART III.	
GENERAL CONCLUSIONS AND SUGGESTIONS	85
Appendix	90
Index	
Index of Tables	94
Index of Graphs	95

- I N T R O D U C T I O N -

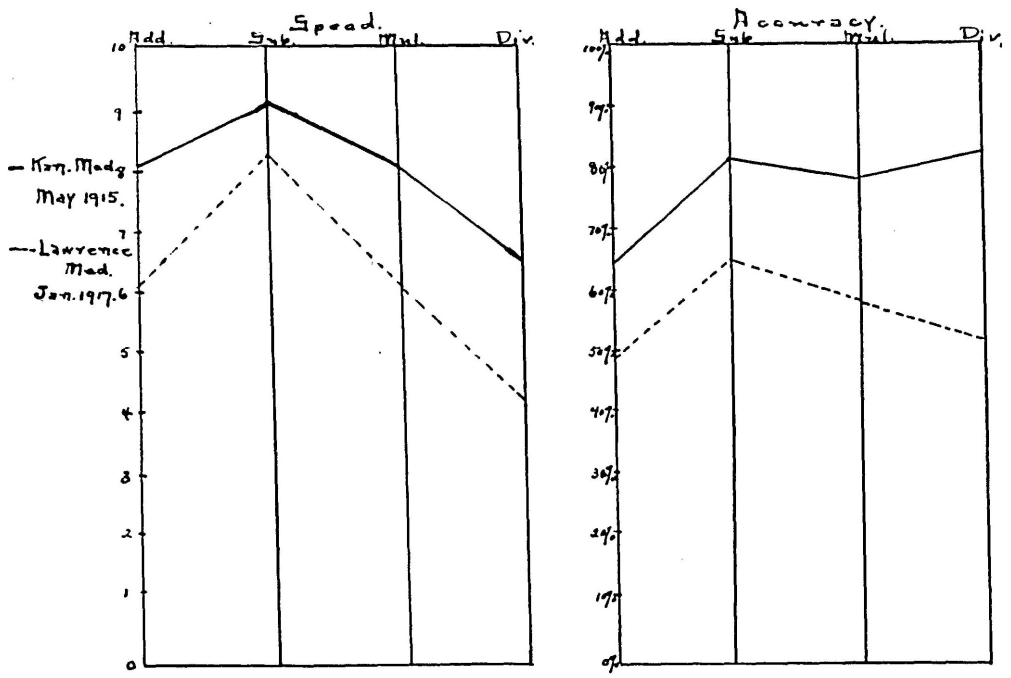
During the month of March in 1917 the investigator administered the Courtis tests Series B[1] to 917 elementary grade children in the public schools of Lawrence Kansas. The investigator had no idea, at the time, of using material from an arithmetic investigation as a subject for a thesis. After the results from the March tests had been recorded according to the Courtis instructions in Folder D, the problem of more efficient drill in fundamentals presented itself to the elementary teachers. The Lawrence medians for all grades were strikingly lower than the medians on the same tests for the state of Kansas as shown by the accompanying graphs.



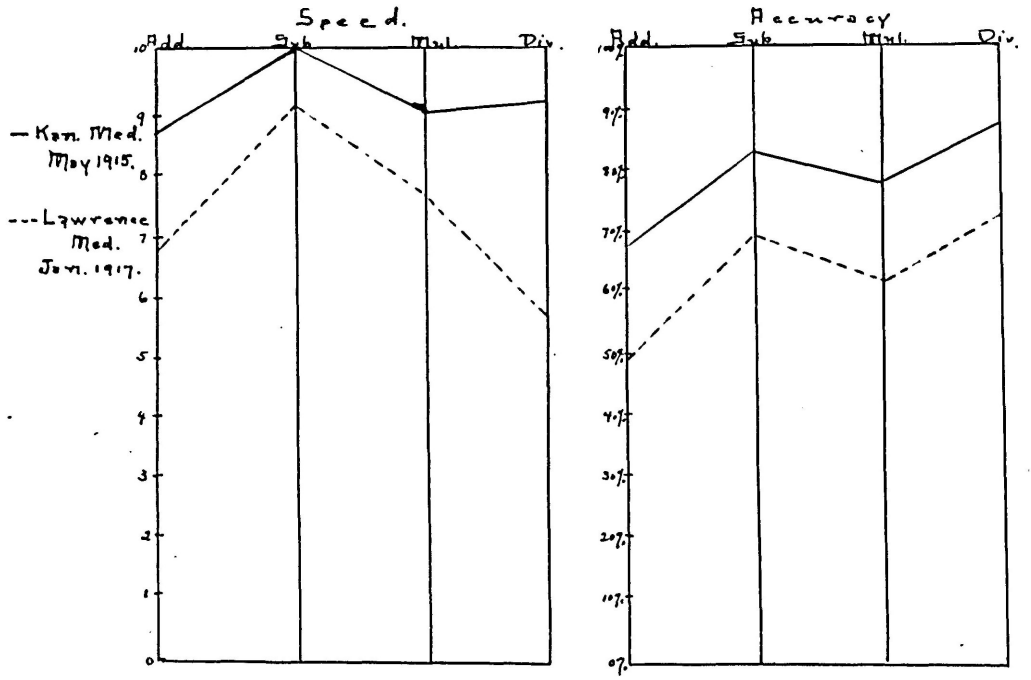
--- Medians for 199 4th Grade Children.



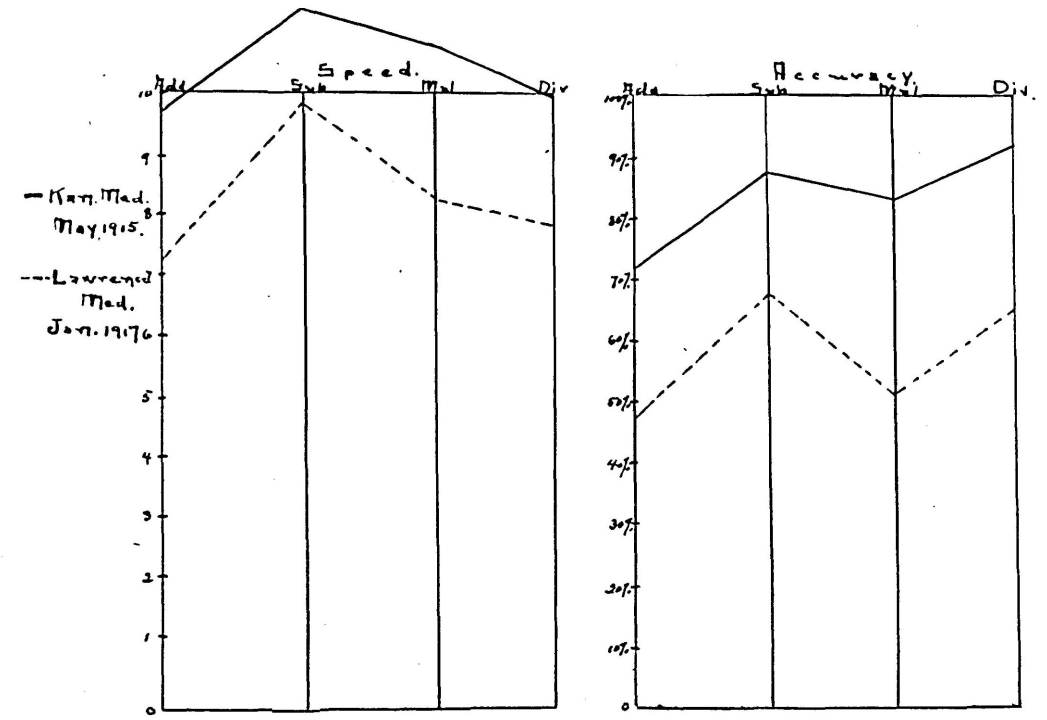
--- Medians for 215 5th Grade Children.



--- Medians for 183 6th Grade Children.



--- Medians for 183 7th Grade Children.



--- Medians for 137 8th Grade Children.

The graphs show further that in every grade except the seventh the Lawrence children more nearly approximated the Kansas medians in speed than in accuracy.

A few of the teachers who had volunteered to assist the investigator in tabulating the results were moved to action. Teachers from two closely situated schools requested a box of Studebaker[2] practice material in the arithmetic fundamentals. This box costs twelve dollars. In using the material the children can use their ordinary tablet paper. The record sheets for the pupils cost one cent each. The two schools intended to use the material jointly. Teachers from a third school requested a box of Courtis[3] practice material in the arithmetic fundamentals. This box costs six dollars only but the practice pad containing the record sheet presents an extra item of five cents for each pupil. The city superintendent, Raymond A. Kent, secured these boxes and four of his teachers with the help of the investigator, began using the materials.

The use of these materials covered a period of only two weeks. This was at the close of the spring semester and did little along the line of correcting inefficient teaching in arithmetic fundamentals for that term.

This short trial did familiarize the teachers and pupils with the administration of a practice lesson.

As the material was new and novel a new interest in arithmetic fundamentals was created in pupils and patrons.

Teachers in other buildings became interested in the material and borrowed sets of cards[3] to try out on their classes.

By the end of the semester nearly every elementary class in the whole system from the fourth grade up to the eighth was somewhat familiar with one of the two forms of practice material.

At the close of the school year both boxes of cards were returned to the Superintendent's office.

PRESENT PROBLEM.

During the opening month of the fall term of 1917 and 1918 teachers from each of the eight elementary school buildings requested a box of practice material in the arithmetic fundamentals. A few of the teachers in each of these same buildings were of the opinion that definite drill each day on the fundamentals without specially prepared material would accomplish the

same results.

The superintendent was now facing a practical problem in administration. Should he purchase six new boxes of Studebaker material at $12.00 a box ($72.00)? Should he purchase six boxes of Courtis material at $6.00 a box ($36.00) letting the pupils purchase the individual tissue paper pads? Should he purchase three boxes of one kind and three of the other? Or should he return the two boxes already purchased to the three schools which had first requested them and order the other schools to spend ten minutes a day on dictated drill in the arithmetic fundamentals?

The two weeks' use of the materials during the preceding semester had proven nothing regarding any kind of drill. It merely opened up the problem.

Instead of arbitrarily deciding which course of action would most greatly benefit the children and at the same time relieve the teachers, Superintendent Kent asked the previous investigator to make this new problem the subject of a master's thesis.

Briefly, then, the problem of this investigation is, to determine whether the use of the Studebaker practice material or the Courtis practice material or

ordinary classroom drill will secure the greatest gain in the use of arithmetic fundamentals in the elementary grades. Proceedures in teaching are to result from the findings of this investigation.

The investigator chose four buildings - numbered 1- 2- 3- 4 in this investigation for use in solving the problem. Each grade in these buildings is divided into an A and B section. The A section is the highest in a grade and pupils in it are promoted during the middle of the school year into the B class of the next grade. The B class is made up of pupils who become A class pupils of their own grade at mid-year promotion time and thus advance to the next higher grade only at the end of a year. Only sections from the 4th B to the 8th A inclusive are used in this investigation.

During the months of October and November 1917, the investigator personally tested each section in schools 1 - 2 - 3 - 4. The Courtis Tests Series B^1 were used. After the tests the following arrangements were made.

In building No. 1, where only the first six grades are taught, the Courtis material was tried out. This building had used this material during the two weeks of

the previous semester. The sixth grade teacher teaches all sections in arithmetic from the 4th B thro the 6th A section. She appreciated the value of the experiment and entered heartily into her share of it.

In building No. 2, where only the first six grades are taught, the Studebaker practice material was tried out. This building had used this material during the preceding semester. In this school each class[4] except the 4th Grade, has a different teacher for all the work including arithmetic. Three of the four teachers were new in the system and had less interest in the experiment than the teachers of the previous year. However, they readily responded to the suggestions made by the investigator and soon were cooperating heartily in the experiment.

In building No. 3, where all six grades were taught, no practice material was used tho the pupils were somewhat familiar with the Studebaker materials. These teachers felt slighted because they were given no practice material and did not support the investigation so heartily at first. After the investigation was really under way they decided to show schools 1 and 2 what they could do without practice materials.

Building No. 4 housed all the seventh and eighth grade pupils in the city. Both grades were divided into A and B classes and each class into sections. Three sections in each class were used in this investigation.

The seventh grade sections were taught by a woman who was interested in this investigation from the first. She, more than anyone else in the system, had to contend with insufficient training in the fundamentals. Three sections in each 7th B and each 7th A classes were tested and used in this experiment.

The eighth grade sections were taught by a man who was only mildly interested in the fundamentals in arithmetic. However, he took kindly to the investigation and followed instructions. Three sections in each 8th B and each 8th A classes were tested and used in this investigation.

In each 7th and 8th grade, sections 1 of the A and B classes were drilled with the Courtis practice material in the fundamentals of arithmetic.[5] Sections 2 of the A and B classes were drilled with the Studebaker practice material. Sections 3 had no practice material but were given the same amount of time for oral or written dictated drill on the fundamentals.

The drill in all groups progressed steadily for twenty days. Where the material was used by the teacher for the first time the investigator demonstrated its use in an actual class period with the teachers observing.

During the progress of the drills the investigator made three visits to each room to observe the progress of the pupils, to note the reactions of the best or poorest pupils toward the drills, to encourage and advise the teacher and to answer any questions arising in connection with the work.

Enforced closing of schools because of coal shortage in December and cessation of drills because of large numbers out with measles made the period covered longer for some grades than others. However, each grade had twenty days for drill in spite of the confusion caused by these interruptions.

The regular Courtis and Studebaker shortest drill times were observed.

COURTIS TIME

4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
5-3/4 min.	4-3/4 min.	4 min.	3-1/2 min.	3 min.

STUDEBAKER TIME

6-1/2 min.	5-1/2 min.	4-1/2 min.	4 min.	3-1/2 min.

DICTATED DRILL TIME

4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
15 min.	12 min.	10 min.	8 min.	8 min.

While the Courtis and Studebaker groups had but the short time indicated in the above table for actual drill work, considerable time was expended in passing and collecting cards. The amount of time needed for this depended upon the organizing ability of the teacher and varied from grade to grade. The average amount of time needed for the routine work of passing the cards plus the actual drill work was found to range from 15 minutes in the 4th grade to 8 minutes in the 8th grade. Upon this basis the time for the dictated drill work was made out.

After twenty days of continuous and regular practice on the fundamentals as described above all sections were tested a second time by the Courtis Tests B^1. The following results recorded by grades show the relative values of the Courtis and the Studebaker and Dictated drills in the four fundamental operations in whole numbers in arithmetic.

PREVIOUS INVESTIGATIONS.

No investigator, to my knowledge, has at any time attempted to find out the relative values between the use of any two standard practice materials and dictated drill. Mr. S. A. Courtis has experimented with the Courtis practice material in the Detroit, Michigan, schools. His results are published in his "Annual Accounting" series.

N. L. Uhl experimenting at Northwestern University points out the value of using the S. A. Courtis material in "The Use of Standardized Materials in Arithmetic for Diagnosing Pupils' Methods of Work".[6] In this report he emphasizes the fact that by using the practice material a teacher can discover clumsy methods of work, analyze the child's difficulty, and give special drill to remedy the defect.

This is just what the teachers using the Courtis and Studebaker materials began to do when pupils in their classes were still on card No. 1 after four or five days of drill. When individuals fall behind in the old

dictation method it is not so noticeable from day to day, besides these children are not being kept on the same problems long enough for the teacher to analyze the trouble.

In 1911, J. C. Brown gave the results of thirty days drill in an article entitled, "An Investigation on the Value of Drill Work in the Fundamental Operations of Arithmetic".[7] He tested 6th, 7th and 8th grade classes with Stones Fundamental Test. Drilled part of these for thirty days and used part as control classes with no drill. At the end of 30 days of work, the classes were again given the same Stone test. "The benefit was most marked in the 6th grade, and least marked in the 8th grade, although it was significant in all three grades." The two later studies recorded in the November and December 1912 editions of the Jr. of Ed. Ps. merely confirm the above conclusion.

The investigation most comparable to the one here presented is that by H. G. Childs entitled "A Half Year's Progress in the Achievement of One School System (as measured by the Courtis Tests B.)"[8] He gave the Courtis Tests B. to 809 Bloomington Indiana school children in February 1915. Then in June, he again gave

the same tests. No change was made in the class proceedure for any of the five grades except that the 6th, 7th and 8th grades were given 5 minutes drill in addition only, during the semester.

No improvement worth mentioning was noted in any of the grades except in the case of addition where the drilled classes improved 42% in rights and 14% in accuracy. However, these same classes showed no noticeable improvement in the other three fundamentals so that the investigation showed that there was no transfer of training from one form to another.

Mr. Childs stated that what little improvement was shown, was most noticeable in the fourth grade.

These investigations prove conclusively the value of drill but do not attempt to point out the value of different types of drill. This investigation now has that task before it.

PART I.

INTERMEDIATE GRADES.

CHAPTER I.

FOURTH GRADE RESULTS.

As stated in the introduction, School No.2 used the Studebaker Practice Material and School No.3 spent the same amount of time in Dictated Drill for 20 days. These Dictated Drills in all cases were conducted by the class teacher without suggestions from the investigator.

Tables 1 and 2 compare the medians of each B and A class in the 1st and 2nd trials. These medians were computed with the aid of the regular Courtis Standard Record Sheets.[9]

Graphs 1 to 4 inclusive are made from the data tabulated in tables 1 and 2. The base line used in these graphs is the median score for 199 Lawrence Kansas 4th Grade children tested by the investigator in January 1917.

Graphs 1 and 2 show that in the 1st test the B classes of Schools 2 and 3 were below the 1917 Grade

medians. This is particularly apparent in division where the children had not been taught long division at all. Note the progress made in this process in School 2 (Graph 1). School 3 did not work on long division at all but concentrated its efforts on the other processes.

Graphs 3 and 4 show that the A classes of these two schools ranged well around the 1917 Fourth Grade medians. Both classes made remarkable progress in both speed and accuracy and in all processes in 20 days.

Tables 3 and 4 compare the gains in per cent of the second trials over the first. These gains were computed from Tables 1 and 2. Graphs 5 and 6 illustrate the relative proportion of gain in the four fundamentals in arithmetic for each school.

The result of different emphasis on processes is clearly illustrated in Graph 5. School 2 spent its time on division while School 3 in Dictated Drill concentrated on the other processes. Graph 6 clearly shows that School 3 Class A made a larger per cent of gain in accuracy in all processes than School 2, Class A.

SUMMARY AND CONCLUSION.

In conclusion it may be said that Graphs 5 and 6 show the following facts in regard to increase in ability to solve the Courtis problems in the fundamentals in the fourth grades:

1. In the B classes, School 3 which used no material but had Dictated Drill made a larger per cent of gain in all processes except in division.
2. In the A classes nearly the same condition holds true except in accuracy in division and rate in multiplication and division.
3. Comparison of Total Gains in all Processes.

		Gain in Rate	Gain in Accuracy
Studebaker Material			
School 2	(Class B	26%	55%
	(Class A	33%	38%
No Material but Dictated Drill			
School 3	(Class B	8%	37%
	(Class A	48%	89%

Note - Table 3 was arbitrarily taken as 100%)

Class B. School 2 made a larger gain than Class B School 3.

Class A. School 2 was greatly surpassed in rate and accuracy by Class A.School 3.

4. In the Fourth B Class, the Studebaker surpassed the Dictated Drill pupils.

5. In the Fourth A Class the Dictated Drill pupils far surpassed the Studebaker pupils.

Table 1.

School	No. of Children	Addition				Subtraction				Multiplication				Division			
		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy	
		1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
1																	
2	15	5.5	5.2	26%	55%	4.6	5	43%	43%	3.5	3.6	31%	35%	0	3.6	0%	35%
3	20	5.3	6	25%	31%	4.6	5	33%	56%	4.7	5.2	28%	41%	0	0	0%	0%

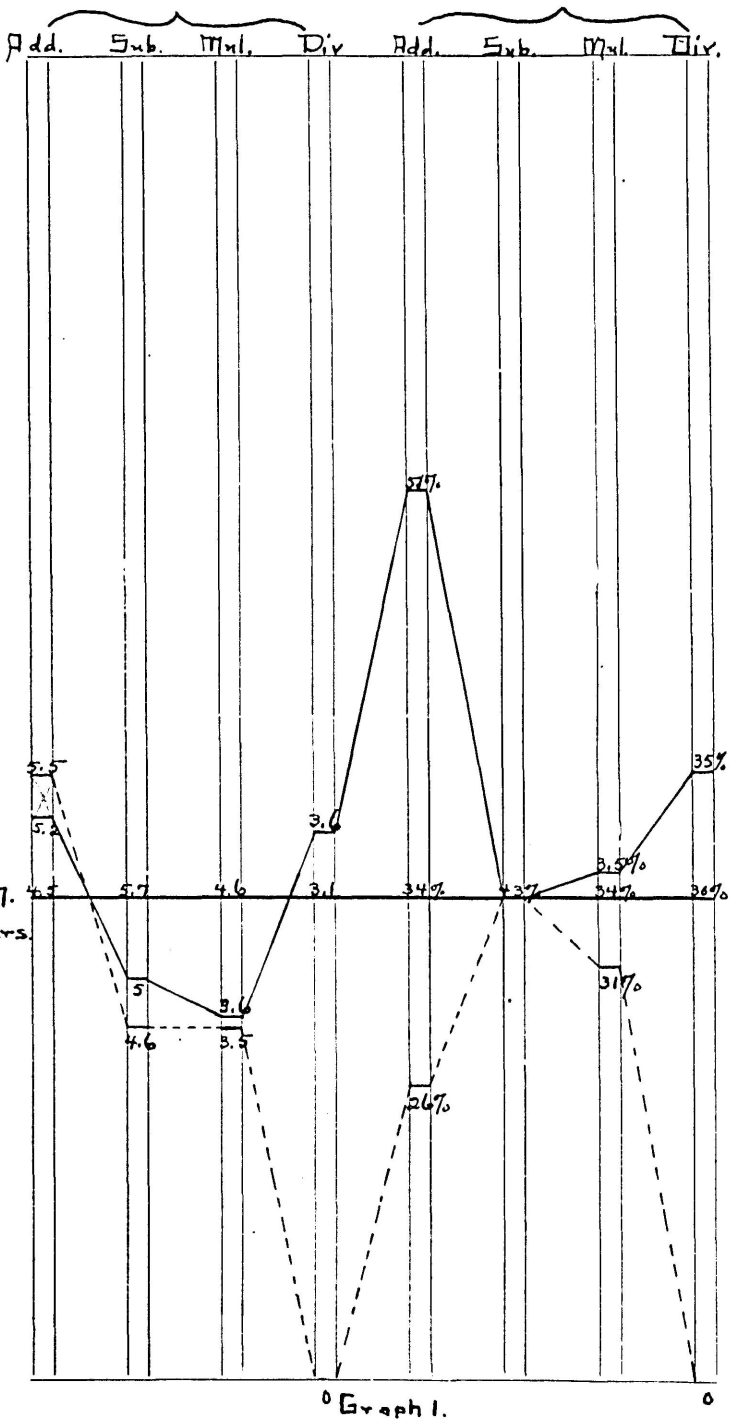
Median Rate and Accuracy — 1st and 2nd Trials for 4B Classes.

Table 2.

School	No. of Children	Addition				Subtraction				Multiplication				Division			
		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy	
		1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
1																	
2	20	5.1	6.2	38%	45%	5.2	6.6	41%	60%	4.7	6	52%	67%	3	5.1	41%	66%
3	13	6.6	8.2	35%	55%	6.3	7.5	35%	80%	7	7	38%	65%	1.6	4	29%	60%

Median Rate and Accuracy - 1st and 2nd Trials for 4A Classes.

School no. 2, 4th B.



Medians.

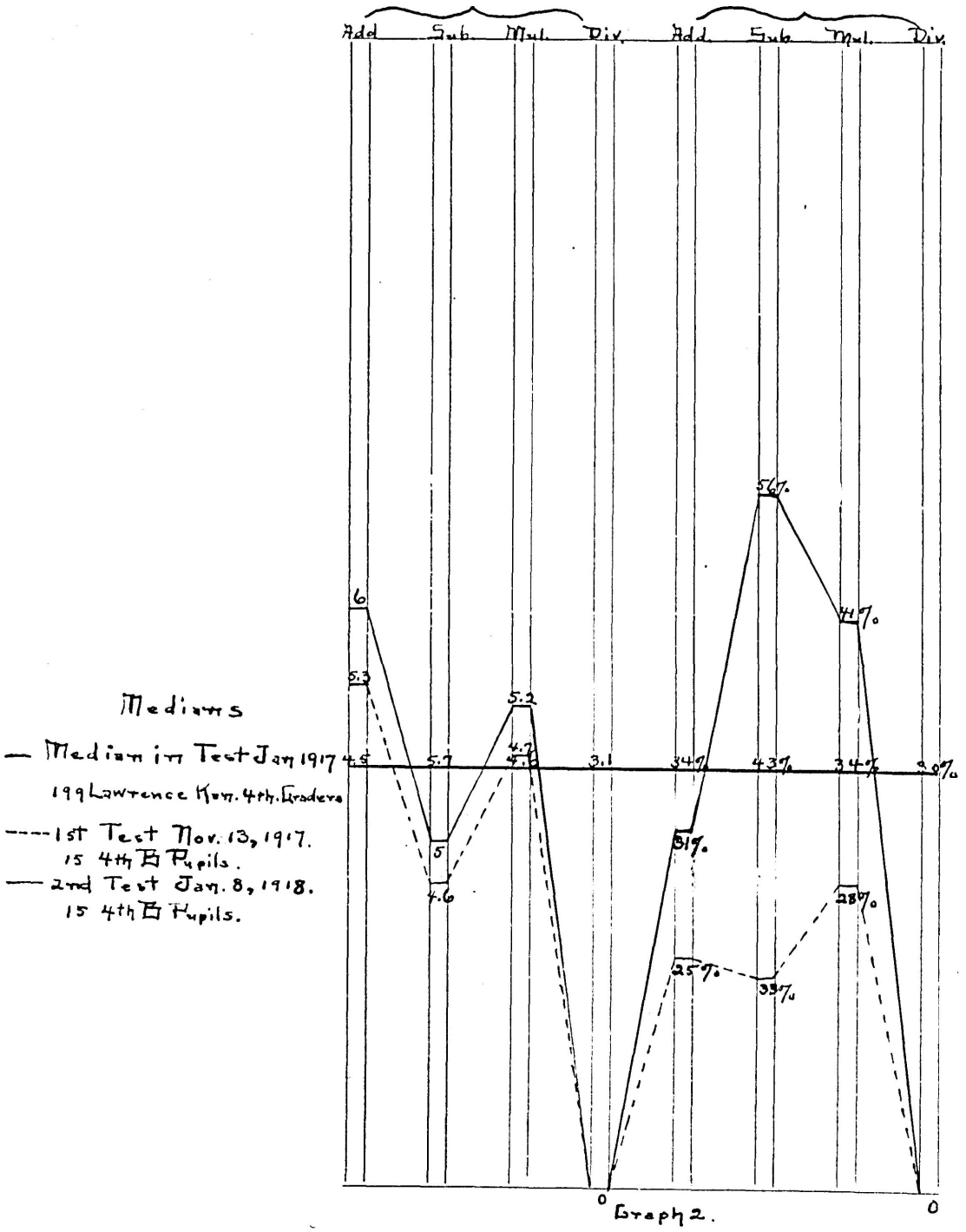
— Median in Test Jan. 1917.
199 Lawrence Ken 4th Graders.

---- 1st Test Mar. 6, 1918.
15 4th B Pupils.

—— 2nd Test May 15, 1918.
15 4th B Pupils.

Used Studebaker Material.

School no. 3, 4th B.



Graph 2.

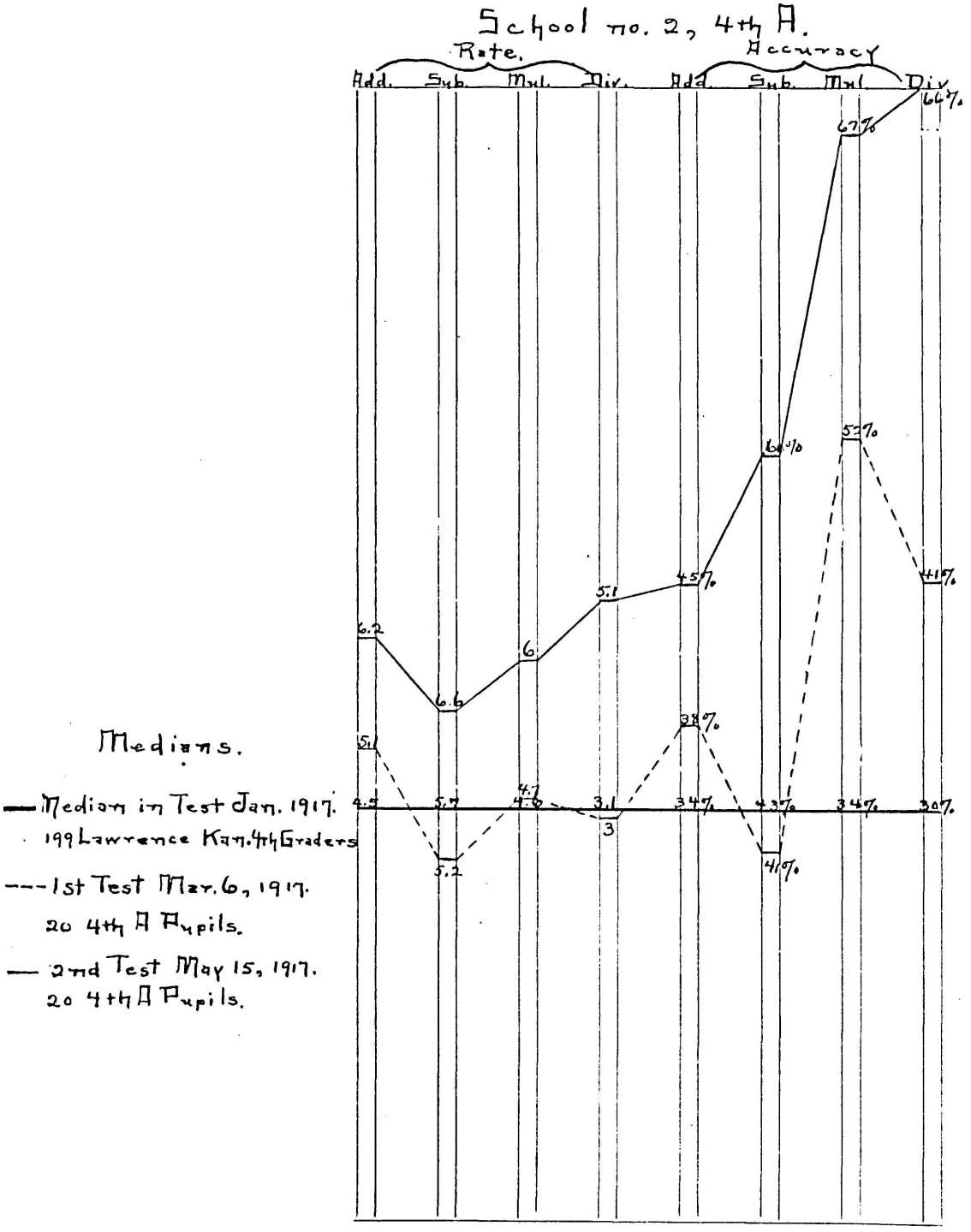
Medians

— Median in Test Jan 1917
199 Lawrence Hon. 4th. Graders

----1st Test Nov. 13, 1917.
15 4th B Pupils.

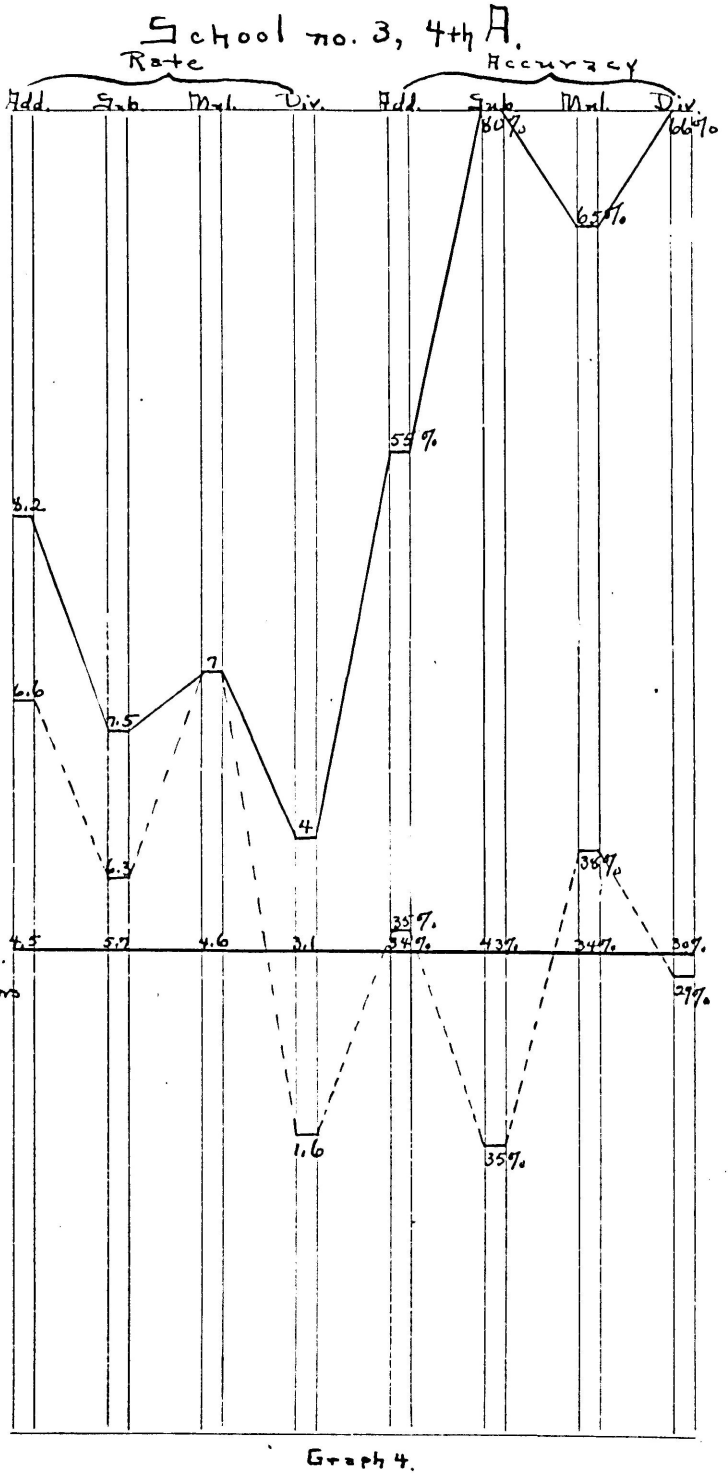
—— 2nd Test Jan. 8, 1918.
15 4th B Pupils.

Used no Material.



Graph 3.

Used Studebaker Material.



Medians

— Median in Test Jan. 1917.
199 Lawrence Nan. 4th Grades

--- 1st Test Nov. 13, 1917.
13 4th A Pupils

— 2nd Test Jan 8., 1918.
13 4th A Pupils.

Graph 4.

Used no Material.

Table 3.

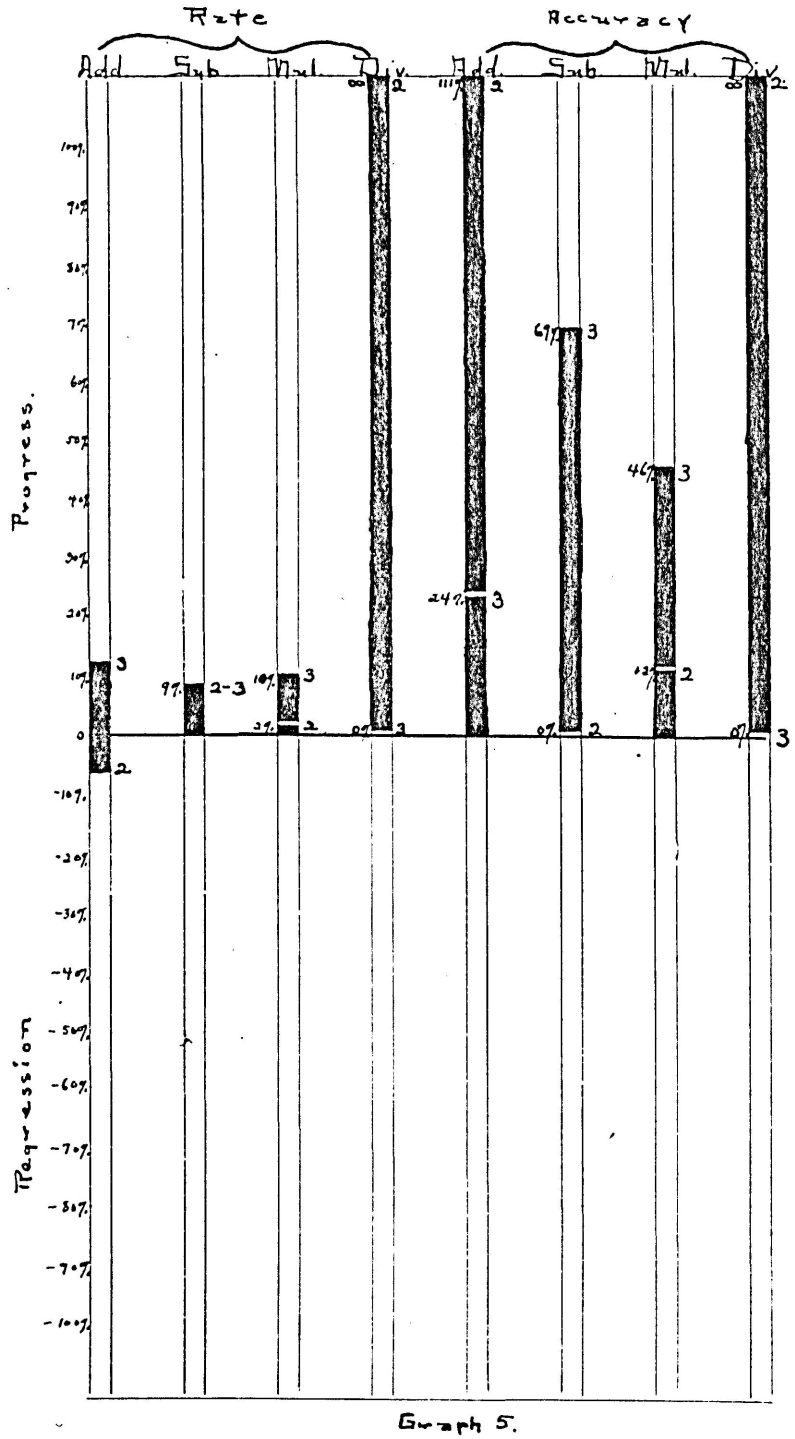
School	No. of Children	Addition				Subtraction				Multiplication				Division			
		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy	
		Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.
1																	
2	15	5%		111%		9%		0%		2%		12%		∞%		∞%	
3	20		13%		24%		9%		69%		10%		46%		0%		0%

Percent of Regression or Progress made in 20 days by 4B Classes.

Table 4.

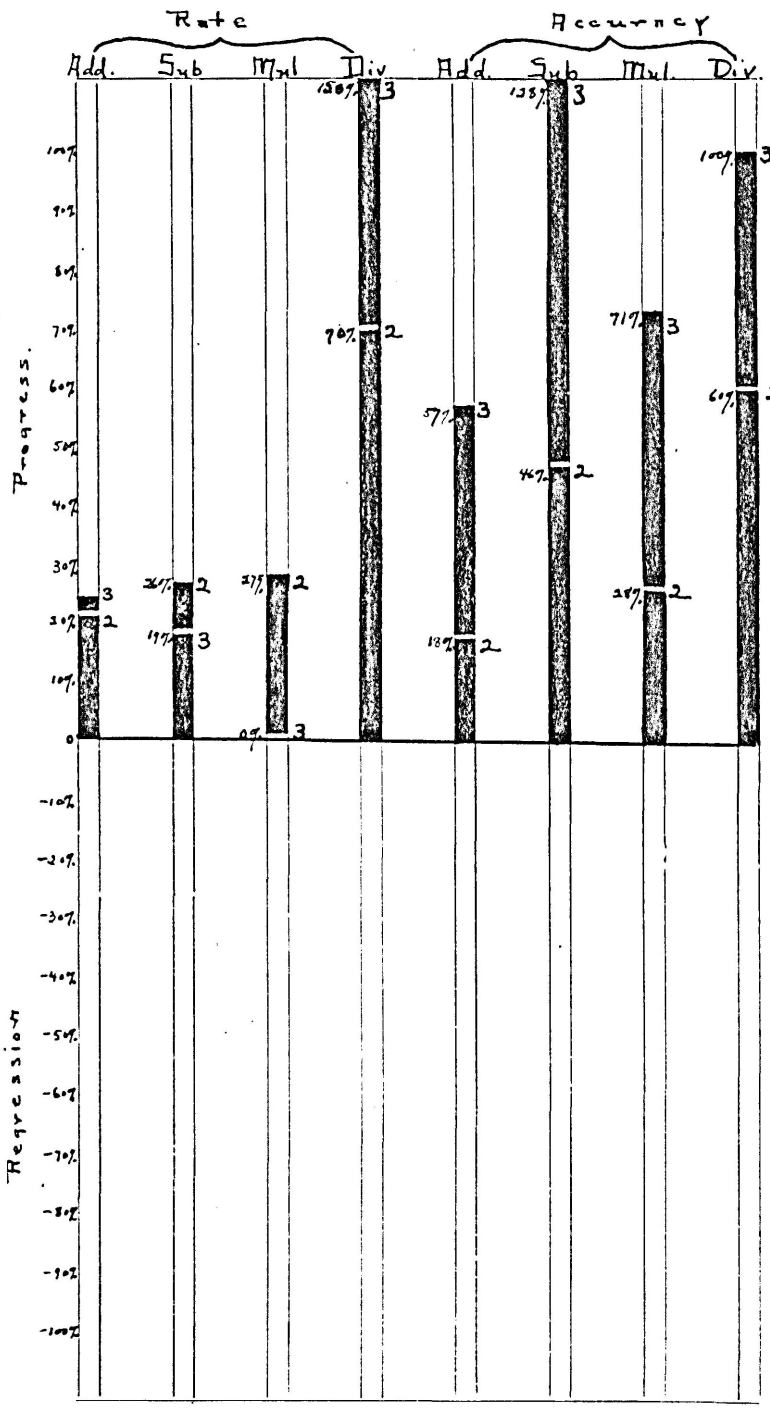
School	No. of Children	Addition				Subtraction				Multiplication				Division			
		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy	
		Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.
1																	
2	20		21%		18%		26%		46%		27%		28%		70%		60%
3	13		24%		57%		19%		128%		0%		71%		150%		100%

Percent of Regression or Progress made in 20 days by 4A Classes.



Graph 5.

Percent of Regression or Progress made in 20 days by 4 B Classes 2-3 no. of Schools.



Graph 6.

Percent of Regression or Progress made in 20 days by 4 A Classes 2-3 no. of Schools.

CHAPTER II.

FIFTH GRADE RESULTS.

The investigation in this grade is particularly interesting as the results from a fourth school, number ④ in this chapter, are added. The fifth A and B classes of this school were tested by the principal at about the same time the investigator gave the tests in other schools. The teacher had no idea that her grade would be tested again at the end of twenty days' work, therefore there was no changing of her regular routine of work for the sake of showing up well for the investigator. The results from school ④ simply show where ordinary school practice might take a class.

As in the introduction, School No.1 used the Courtis practice material, School No. 2 the Studebaker material, School No. 3 the Regular Dictated Drill and School No. ④ the ordinary class drill with the added handicap as stated above.

Tables 1 and 2 compare the medians of each B and A class in the 1st and 2nd trials. These medians were computed with the aid of the regular Courtis Standard

Record Sheets.

Graphs 1 to 7 inclusive are made from the data tabulated in tables 1 and 2. The base line used in these graphs is the median score for 215 Lawrence Kansas 5th Grade children tested by the investigator in January 1917.

Graphs 1, 2, 3 and 4 show that in the first test Schools 1 and 2 were far below Schools 3 and ④ in accuracy. School No. 1 was consistantly below the 1917 Grade medians in accuracy in the first test. Schools 2 and 3 were more equal in accuracy variability. School No. ④ ranked high in accuracy in the first test.

Graphs 5, 6 and 7 show that the A classes of Schools 1, 3 and ④ ranked high in accuracy in the first test over the 1917 Lawrence medians. The gains made in per cents in 20 days were not as remarkable as the gains made in the B classes of these same grades.

Tables 3 and 4 compare the gains in per cent of the second trials over the first. These gains were computed from Tables 1 and 2. Graphs 8 and 9 illustrate the relative proportion of gains in the four fundamentals for each school.

Graphs 8 and 9 show clearly that the greatest

gains were made by Schools 1, and Schools 3 and ④ only regressed from their own standards set in the 1st trial. This regression was most marked in addition and subtraction. This was possibly due to concentration on multiplication and division.

SUMMARY AND CONCLUSION

In conclusion it may be said that Graphs 5 and 6 show the following facts in regard to increase in ability to solve the Courtis problems in the fundamentals in the fifth grade.

1. Schools 1 and 2 never in any process regressed below the median of the 1st test while schools 3 and 4 together regressed 5 times in speed and 8 times in accuracy.
2. Schools 1 and 2 using the Courtis and Studebaker practice materials showed an equalizing of abilities in the second test that is very striking in comparison with the eratic fluctuation of abilities developed in schools 3 and ④ (See Graphs 1-7).
3. The Courtis and Studebaker pupils show a

higher average gain in speed and accuracy than either School 3 or ④.

COMPARISON OF GAINS IN ALL PROCESSES.

		Total Gain Speed	Total Gain Accuracy
Courtis Material			
School 1	Class B	28%	54%
	Class A	29	24
Studebaker Material			
School 2	Class B	11	27
No Material but Dictated Drill and Knew of Test			
School 3	Class B	4	16
	Class A	8	10
No Material but Dictated Drill and Did not know of test.			
School ④	Class B	3	27
	Class A	8	1

4. Considering accuracy only, Schools 1 and 2 far surpass the other schools except in the case of School ④ Class B.

5. Considering speed the first two schools again show by far the largest per cent of gain. This corroborates previous findings that as a rule high accuracy follows high speed.
6. Considering both speed and accuracy School 1 and 2 surpass schools 3 and ④.
7. The Courtis and Studebaker people made the largest per cent of gains in 20 days.
8. In this grade, the Courtis people stood highest in per cent of gain.

Table 1.

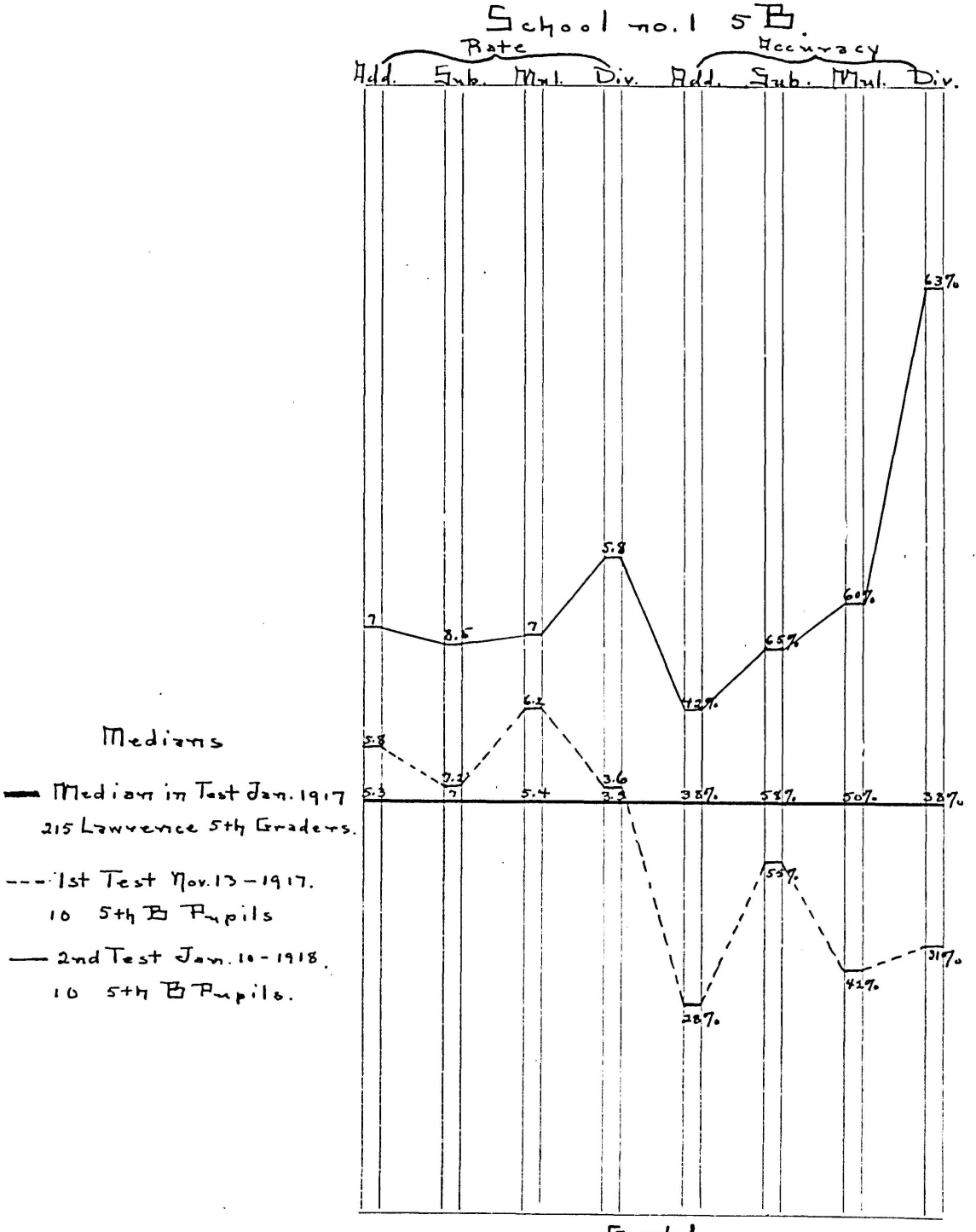
School	No. of Children	Addition Rate 1	Addition Rate 2	Addition Accuracy 1	Addition Accuracy 2	Subtraction Rate 1	Subtraction Rate 2	Subtraction Accuracy 1	Subtraction Accuracy 2	Multiplication Rate 1	Multiplication Rate 2	Multiplication Accuracy 1	Multiplication Accuracy 2	Division Rate 1	Division Rate 2	Division Accuracy 1	Division Accuracy 2
1	10	5.8	7	23%	42%	7.2	8.5	55%	65%	6.2	7	42%	60%	3.6	5.8	31%	63%
2	25	6.2	6.5	43%	43%	5.9	6.8	43%	60%	4.5	5.6	43%	56%	4.2	4.4	40%	56%
3	11	8.2	7.5	60%	50%	5.3	6.3	70%	64%	6	6.5	42%	65%	5	5	33⅓%	60%
④	17	6.4	6	40%	65%	6.5	6.8	80%	70%	5.6	6.1	63%	61%	4.7	5	50%	90%

Median Rate and Accuracy - 1st and 2nd Trials for 5B Classes.

Table 2.

School	No. of Children	Addition Rate 1	Addition Rate 2	Addition Accuracy 1	Addition Accuracy 2	Subtraction Rate 1	Subtraction Rate 2	Subtraction Accuracy 1	Subtraction Accuracy 2	Multiplication Rate 1	Multiplication Rate 2	Multiplication Accuracy 1	Multiplication Accuracy 2	Division Rate 1	Division Rate 2	Division Accuracy 1	Division Accuracy 2
1	20	6.4	8.2	45%	63%	6.6	8.7	82%	82%	6.1	6.5	60%	65%	3.8	5.8	54%	82%
2																	
3	13	7	6.6	52%	44%	5.7	7	73%	65%	5	6.4	44%	60%	5	4.5	50%	65%
④	13	6.1	6.2	63%	55%	6.6	8	70%	85%	5.3	5.5	70%	70%	5	5.5	70%	65%

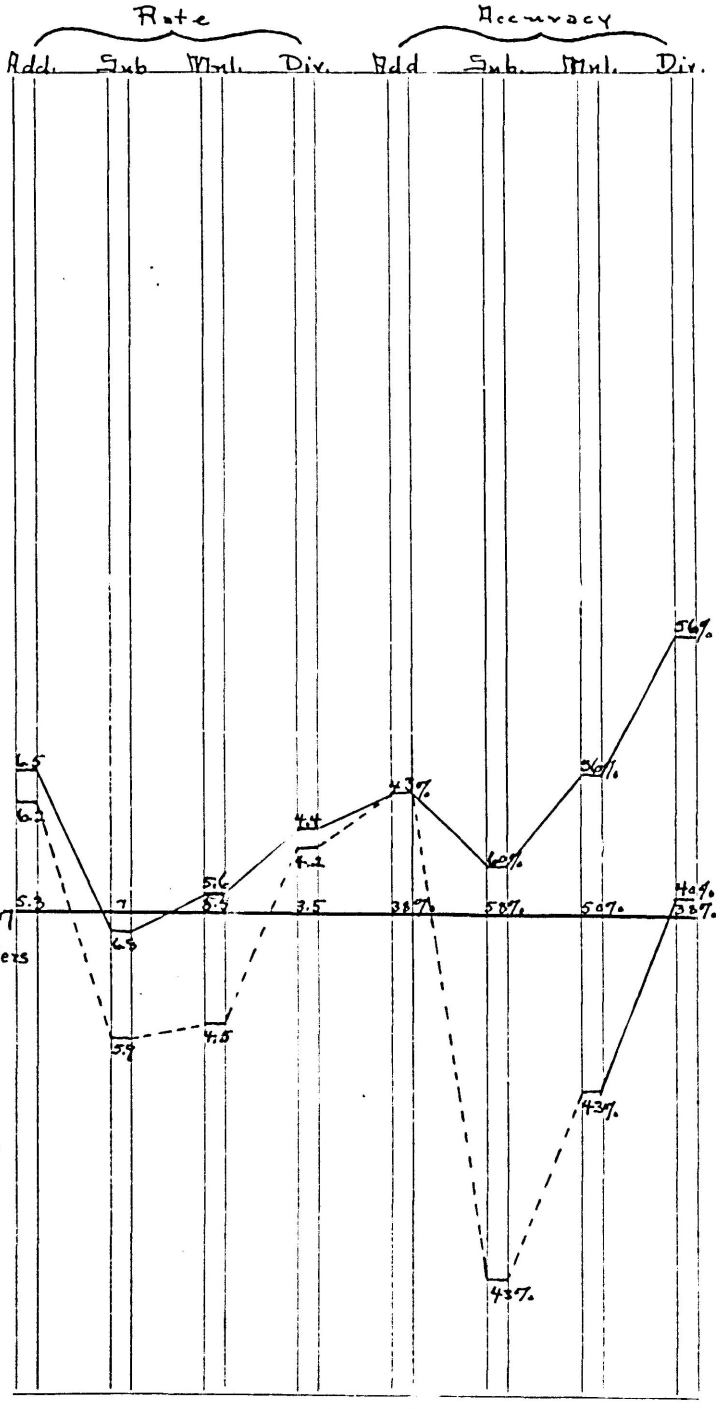
Median Rate and Accuracy - 1st and 2nd Trials for 5A Classes.



Graph 1.

Used Courtis Material.

School no. 2 5th B.



Medians.

— Median in Test Jan. 1917
215 Lawrence Nov. 5th Graders

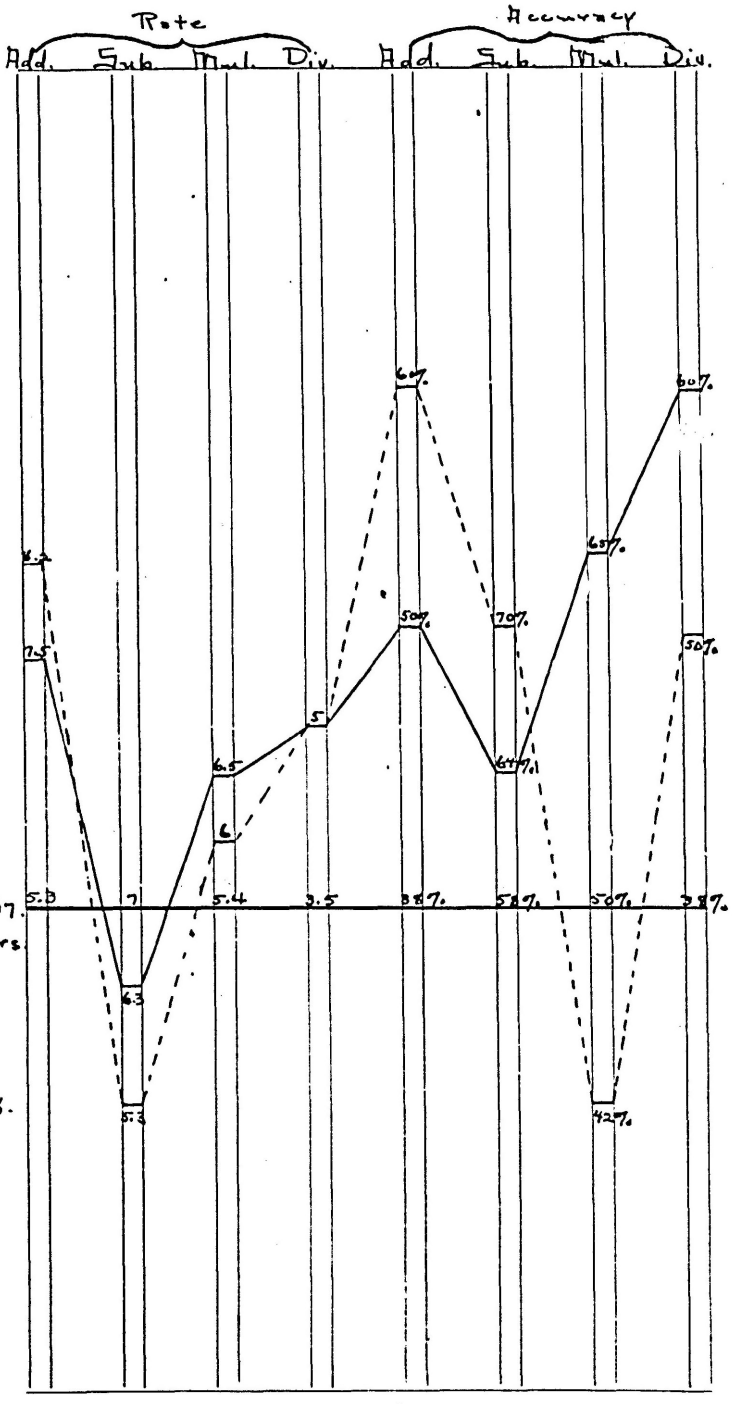
--- 1st Test Nov. 13-1917.
25 5th B Pupils.

— 2nd Test Jan. 10-1918
25 5th B Pupils.

Graph 2.

Used Studebaker Material.

School no. 3 5th B.



Medians.

—— Median in Test Jan. 1917.
215 Lawrence 5th Graders.

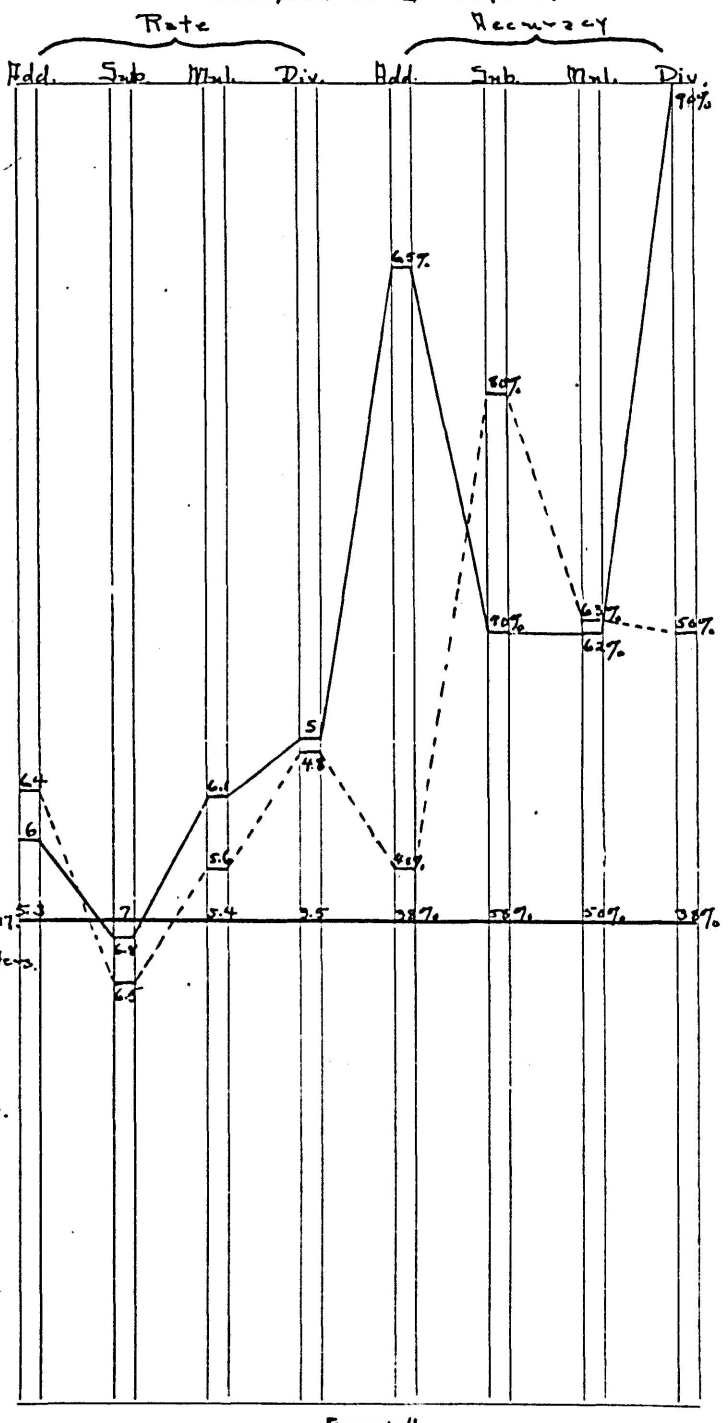
--- 1st Test Nov. 13-1917.
" 5th B Pupils.

—— 2nd Test Jan. 10-1918.
" 5th B Pupils.

Graph 3.

Used no Material.

School no ④ 5th B.



Graph 4.

Medians.

— Median in Test Jan. 1917
215 Lawrence Kan. 5th Graders.

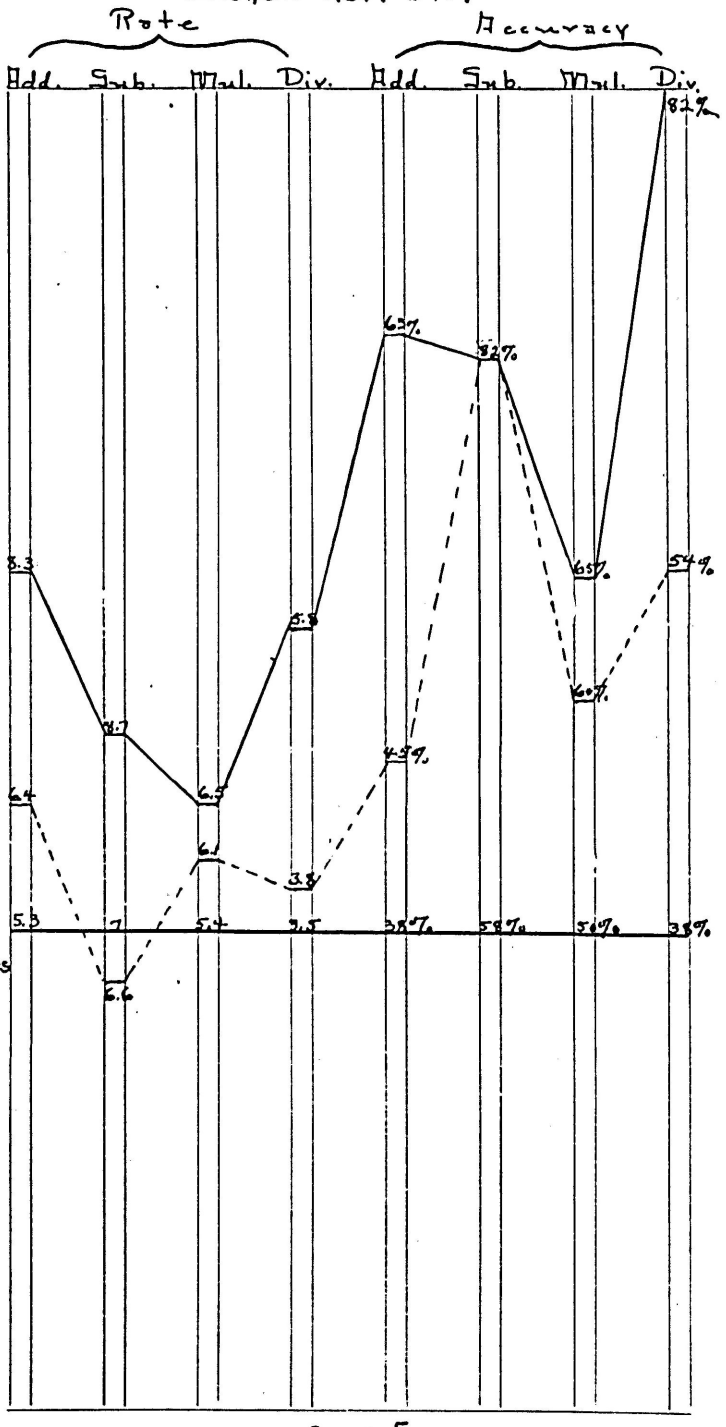
--- 1st Test Nov. 20–1917
17 5th B Pupils.

— 2nd Test Jan. 18-1918.
17 5th B Pupils.

Omit

Used no Material.

School no. 1 5A.



Graph 5.

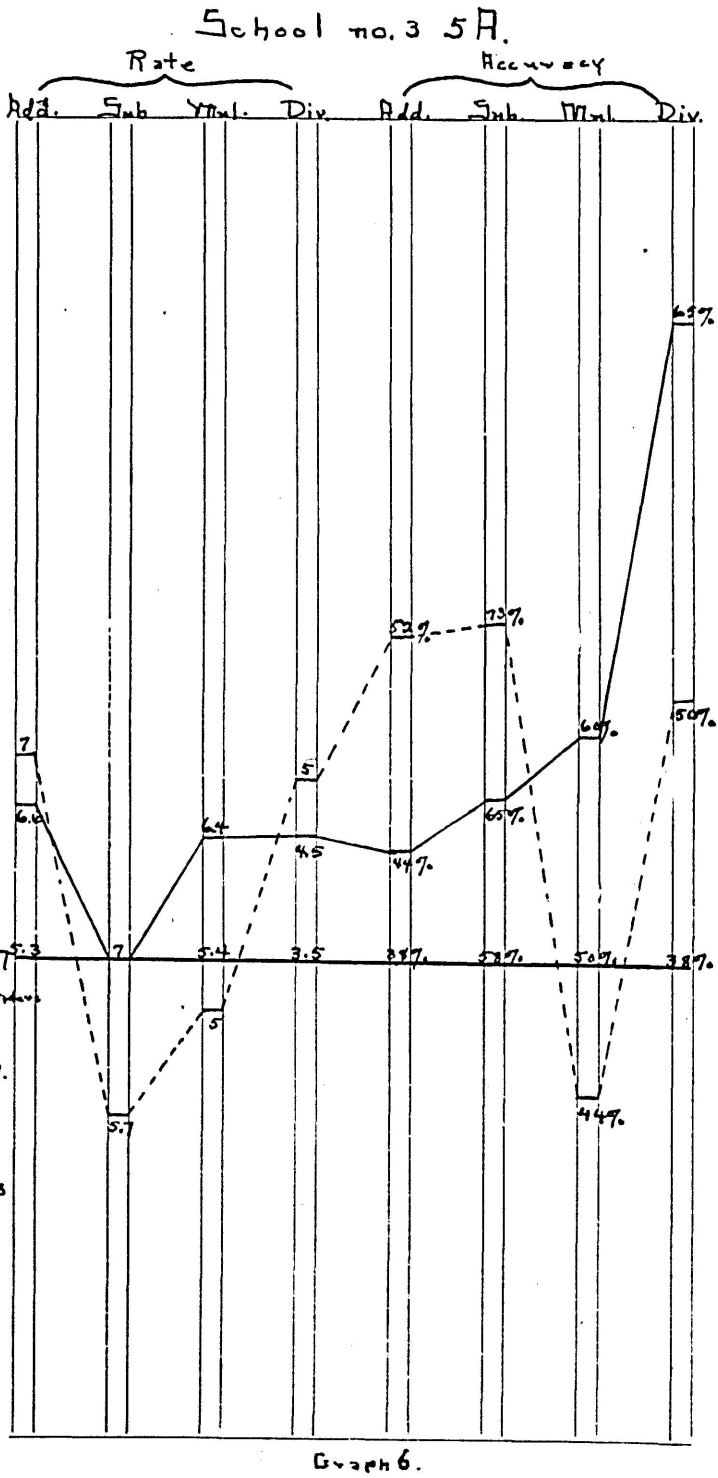
Used Courtis Material.

Medians.

—Median in Test Jan. 1917
215 Lawrence 5th Graders

---1st Test Nov. 13-1917.
20 5th A Pupils.

—— 2nd Test Jan. 10-1918
20 5th A Pupils.



Graph 6.

Medians.

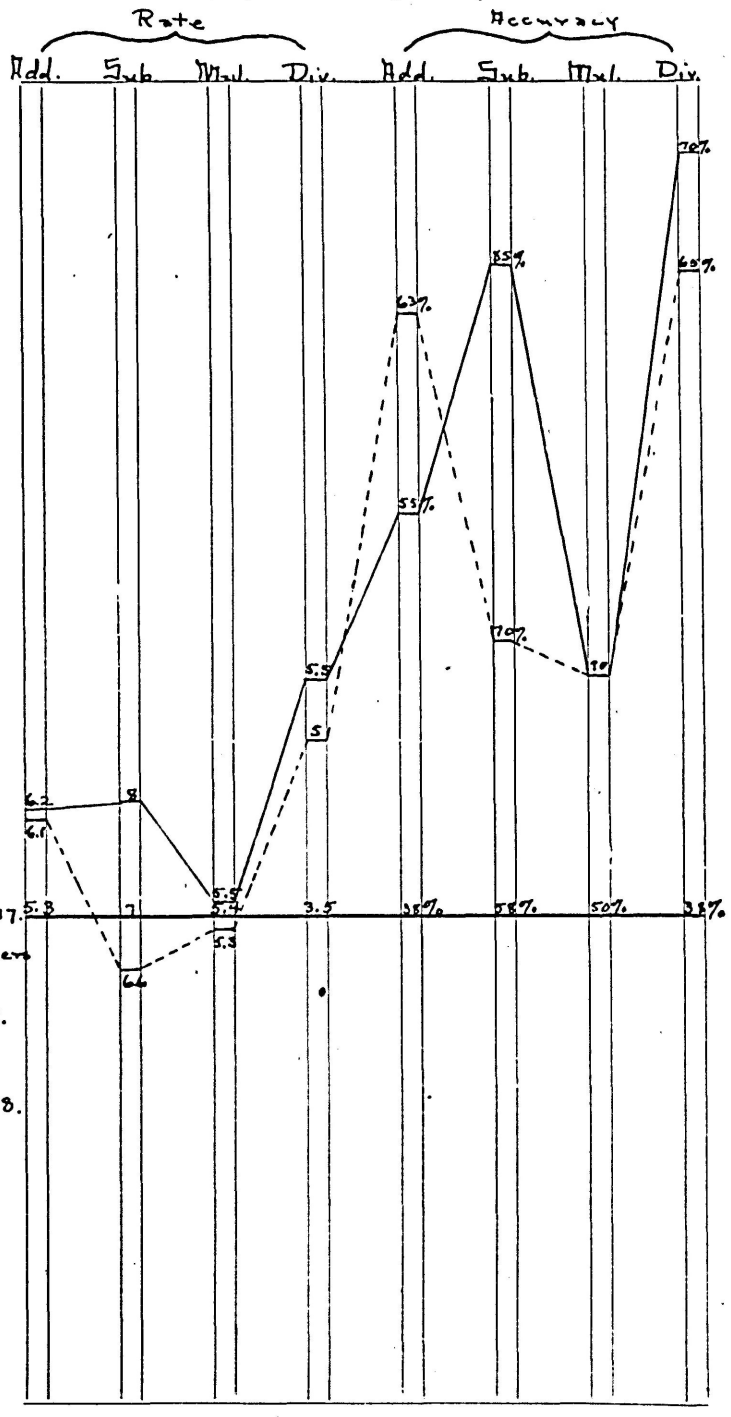
— Median in Test Jan. 1917
215 Lawrence Kan. 5th Grades

--- 1st Test Nov. 13-1917.
13 5th A Pupils.

— 2nd Test Jan. 10-1918
13 5th B Pupils.

Used no Material.

School no. ④ 5th A.



Medians.

— Median in Test Jan. 1917.
215 Lawrence Kan. 5th. Graders

--- 1st Test Nov. 20-1917.
13 5th A Pupils.

— 2nd Test Jan. 18-1918.
13 5th A Pupils.

Graph 7.

Used no Material.

Table 3.

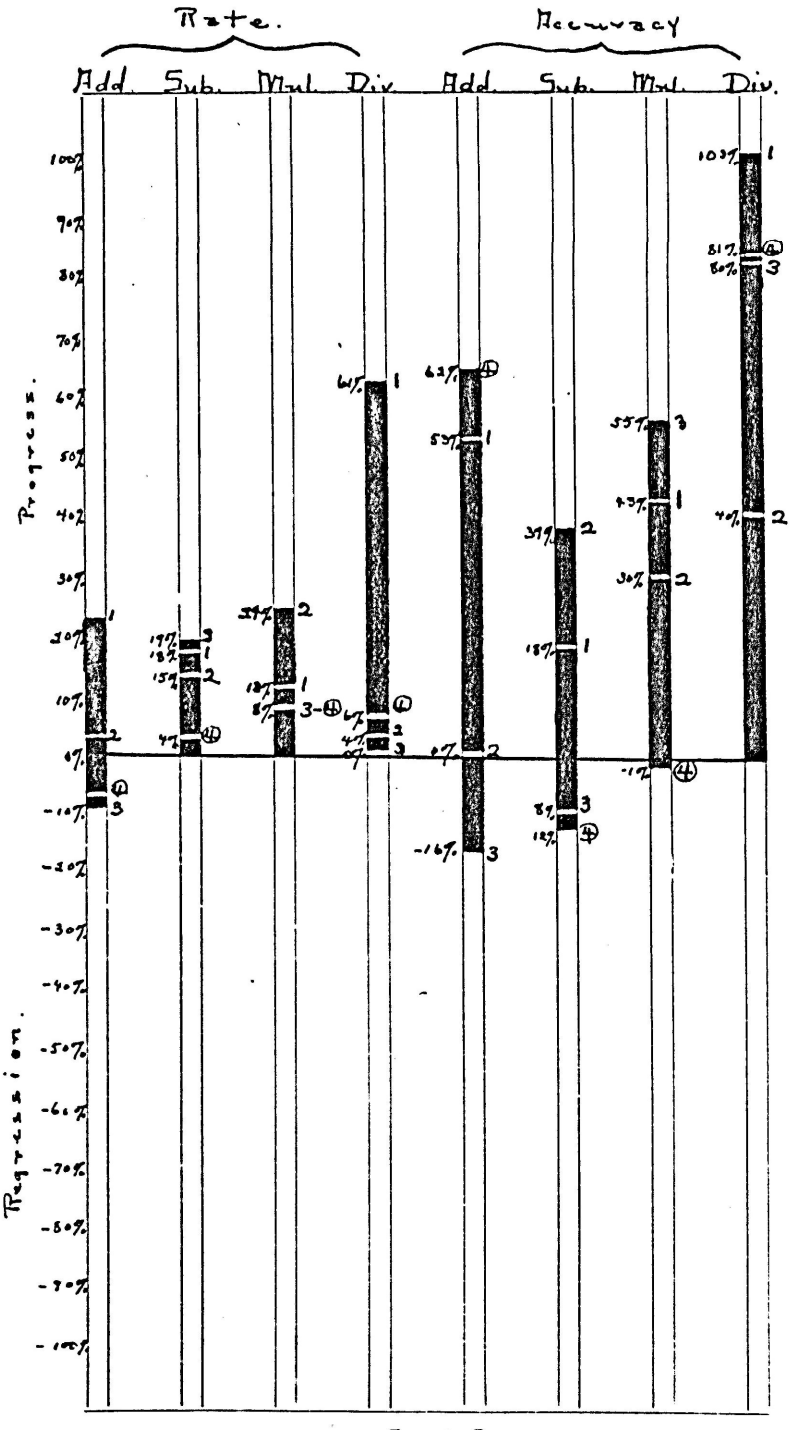
School	No. of Children	Addition				Subtraction				Multiplication				Division			
		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy	
		Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.
1	10		22%		52%		18%		18%		13%		43%		61%		103%
2	25		4%		0%		15%		39%		24%		30%		4%		40%
3	11	8%		16%			19%	8%			8%		55%		0%		81%
⊕	17	6%		62%		4%	12%			8%	1%			6%		80%	

Percent of Regression or Progress made in 20 days by 5B Classes.

Table 4.

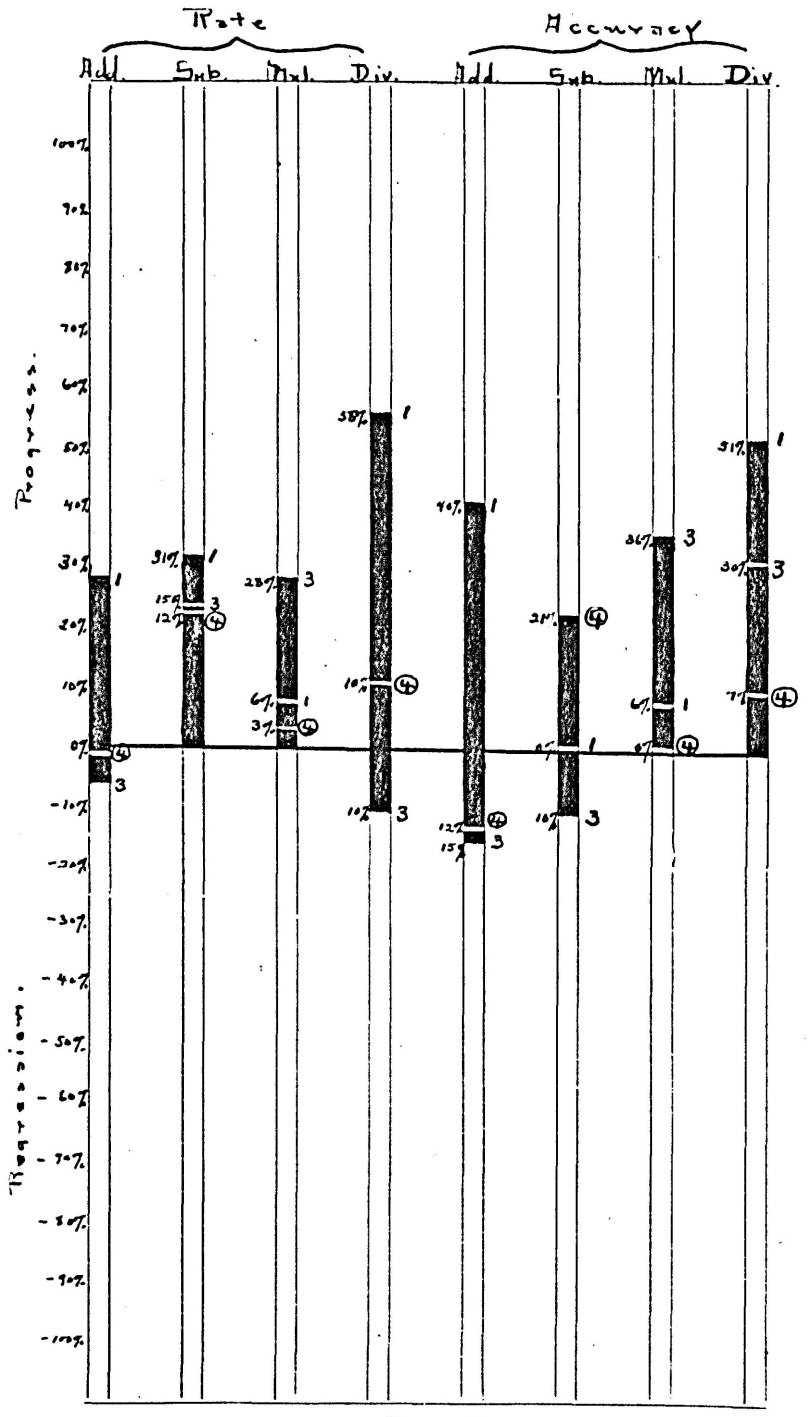
School	No. of Children	Addition				Subtraction				Multiplication				Division			
		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy	
		Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.
1	20		28%		40%		31%		0%		6%		6%		55%		51%
2																	
3	13	5%		15%			22%	10%			28%		36%	10%			30%
⊕	13	1%		12%			21%		21%		3%		0%		10%	7%	

Percent of Regression or Progress made in 20 days by 5A Classes.



Graph 8.

Percent of Regression or Progress made in 20 days by 5B Classes 1-2-3-4 no. of Schools.



Graph 9.

Percent of Regression or Progress made in 20 days by 5 A Classes. 1-3-4 no. of Schools.

CHAPTER III.

SIXTH GRADE RESULTS.

As stated in the introduction, School No. 1 used the Courtis Practice Material, School No. 2 the Studebaker Practice Material and School No. 3 spent the same amount of time in Dictated Drill for 20 days.

Tables 1 and 2 compare the medians of each B and A class in the 1st and 2nd trials. These medians were computed with the aid of the regular Courtis Standard Record Sheets.

Graphs 1 to 5 inclusive are made from the data tabulated in tables 1 and 2. The base line used in these graphs is the median score for 183 Lawrence Kansas 6th Grade children tested by the investigator in January 1917.

Graphs 1 and 2 show that the B classes of Schools 1 and 3 were widely divergent in ability in the 1st test. But the B class of School 3 which was so markedly superior in the first test regressed to the 1st median of School 1 while School 1 progressed in all processes except accuracy in multiplication.

Graphs 3, 4 and 5 show the three possible combinations in rate and accuracy. School 1 class A stood higher in both tests in accuracy than in rate. School 2 represents a fluctuating type, all somewhat higher than the 1917 Lawrence medians, except rate in multiplication. Rate and accuracy are about equally high above the 1917 Lawrence medians. School No. 3 ranked exceptionally high in speed and comparatively low in accuracy in both tests. Both Schools 1 and 3 show results contrary to the general idea that a high rate of speed and a high per cent of accuracy went hand in hand. Graphs 1, 3 and 5 show that the B and A classes of school 1 and the A class of school 3 made consistant progress during the twenty days.

Tables 3 and 4 compare the gains in per cent of the second trial over the first. These gains were computed from Tables 1 and 2. Graphs 6 and 7 illustrate the relative proportion of gains in the four fundamentals in arithmetic for each school.

SUMMARY AND CONCLUSION.

In conclusion, it may be said that Graphs 6 and 7 show the following facts in regard to increase in ability to solve the Courtis problems in the sixth grades:

1. In the B classes School 3 regressed in three operations in accuracy and in rate in division.
2. School No. 1 plainly gained a greater per cent in all operations than School 3.
3. In the A classes School No. 2 only, regressed and here the regression is in three operations in accuracy.
4. School No. 3 made the greatest gains in three operations in accuracy.
5.

COMPARISON OF TOTAL GAINS IN ALL CLASSES

		Total Gain in Rate	Total Gain in Accuracy
Courtis Material			
School 1	Class B	43%	23%
	Class A	36%	29%
Studebaker Material			
School 2	Class A	18%	-4%
Dictated Drill			
School 3	Class B	-2%	-14%
	Class A	33%	42%

6. Schools No. 1 and 3 made the highest gains

in the A classes in Accuracy.

7. Schools No. 2 A class and No 3 B class regressed in accuracy.

8. Considering both classes together in Schools 1 and 3, School 1 surpassed School 3. However, the fact that both the B and A classes in School 3 were not taught by the same teacher while the B and A classes in School 1 were taught by the same teacher may account for the law medians obtained in School 3. Class B. (Note - The regular 6th B teacher in School 3 was absent because of illness during most of the twenty days.)

9. The Studebaker pupils regressed in accuracy during the twenty days drill.

10. The Courtis pupils made the highest per cent of gain in the B and A classes.

Table 3.

School	No. of Children	Addition				Subtraction				Multiplication				Division			
		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy	
		1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
1	20	6	8	38%	56%	6.7	8.2	65%	75%	4.8	7.5	68%	68%	4.5	6.5	55%	75%
2																	
3	19	6.8	7.7	64%	38%	8.1	8.1	80%	75%	6.2	6.2	55%	60%	5	4.5	70%	60%

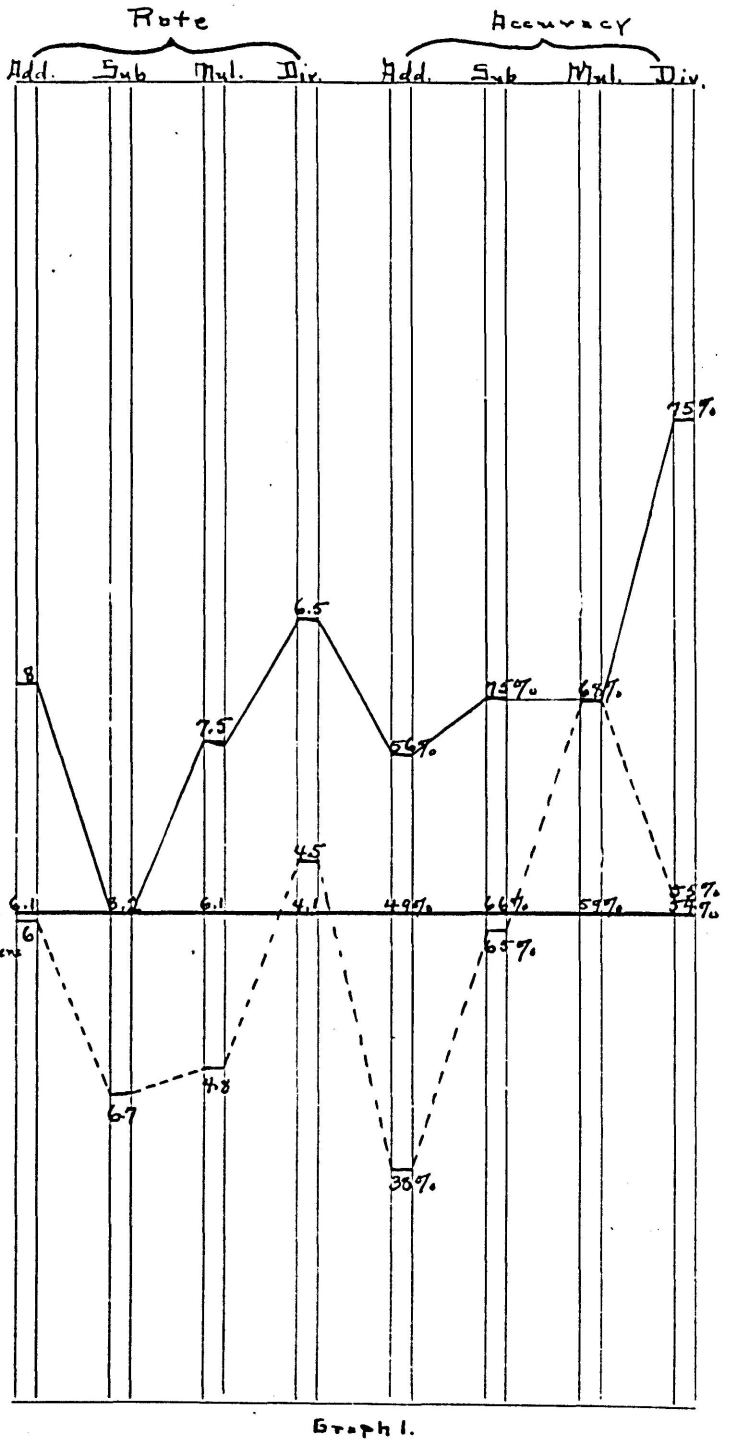
Median Rate and Accuracy - 1st and 2nd Trials for 6 B Classes.

Table 4.

School	No. of Children	Addition				Subtraction				Multiplication				Division			
		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy	
		1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
1	16	6.5	8.5	44	74	6.7	8.5	65	75	5	7	65	73	4.2	6.3	70	85
2	17	6.8	8	64	55	7.7	8.7	70	66	5.8	7.5	63	70	5	5.7	81	72
3	24	8	10.3	42	62	9.4	14	65	77	8	9.2	45	70	6.3	9	58	87

Median Rate and Accuracy - 1st and 2nd Trials for 6 A Classes.

School no. 1 6th B.



Graph 1.

Medians

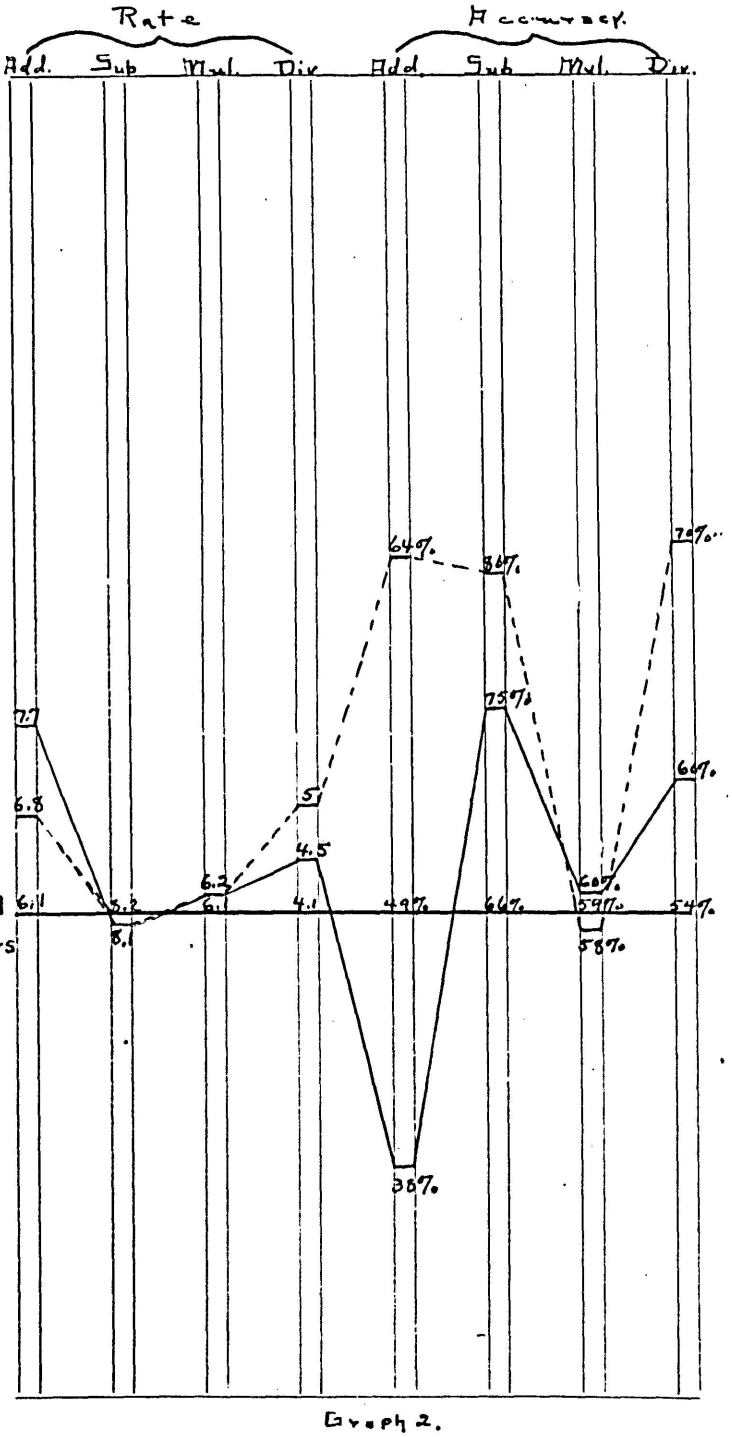
— Median in Test Jan. 1917. 183 Lawrence Kan. 6th Graders

--- 1st Test Nov. 12, 1917. 20, 6th B Pupils.

— 2nd Test Jan 10, 1918. 20 6th B Pupils.

Used Courtis Material.

School no. 3 6th B.



Medians

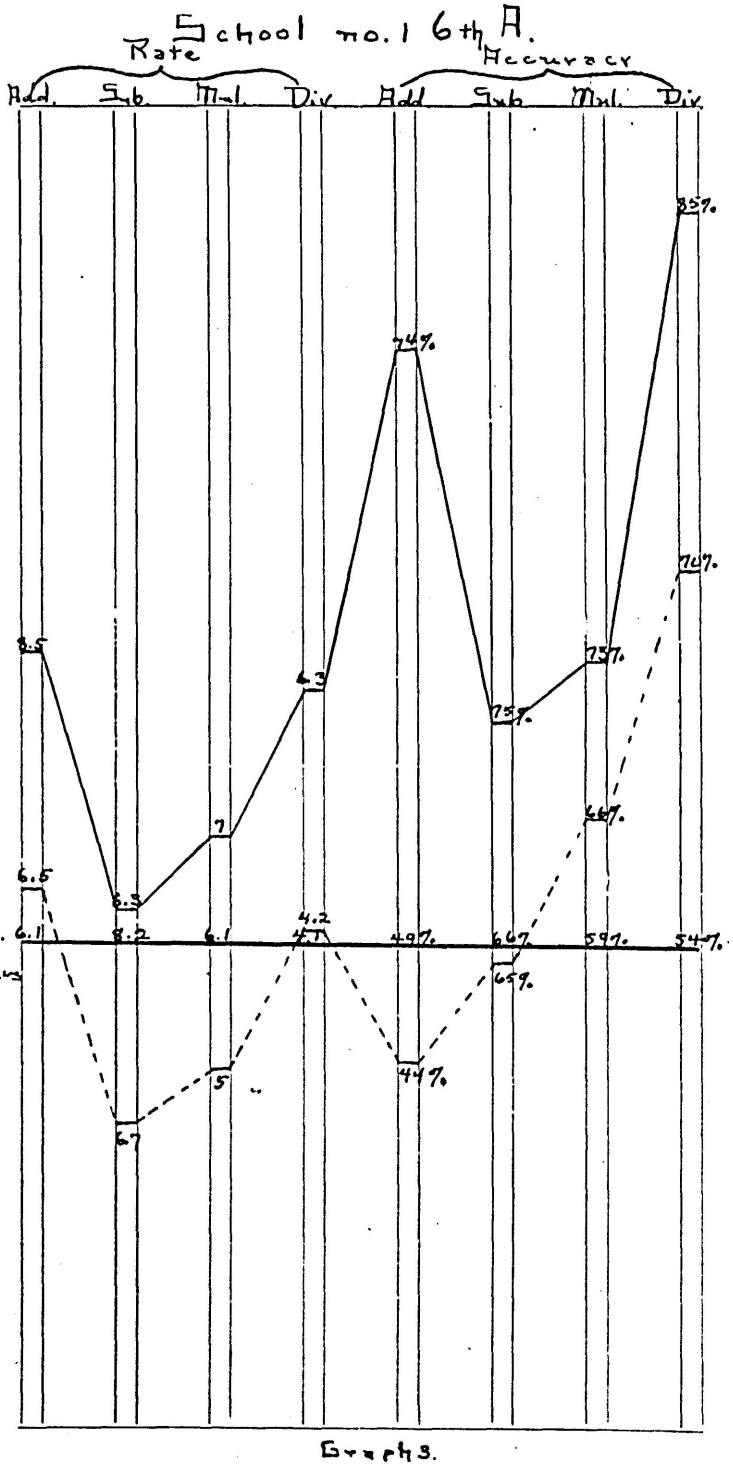
— Median in Test Jan. 1917 183 Lawrence, Kan. 6th Graders

--- 1st Test Nov. 14, 1917. 19 6th B Pupils.

— 2nd Test Jan. 8, 1918. 19 6th B Pupils.

Graph 2.

Used no Material.



Medians

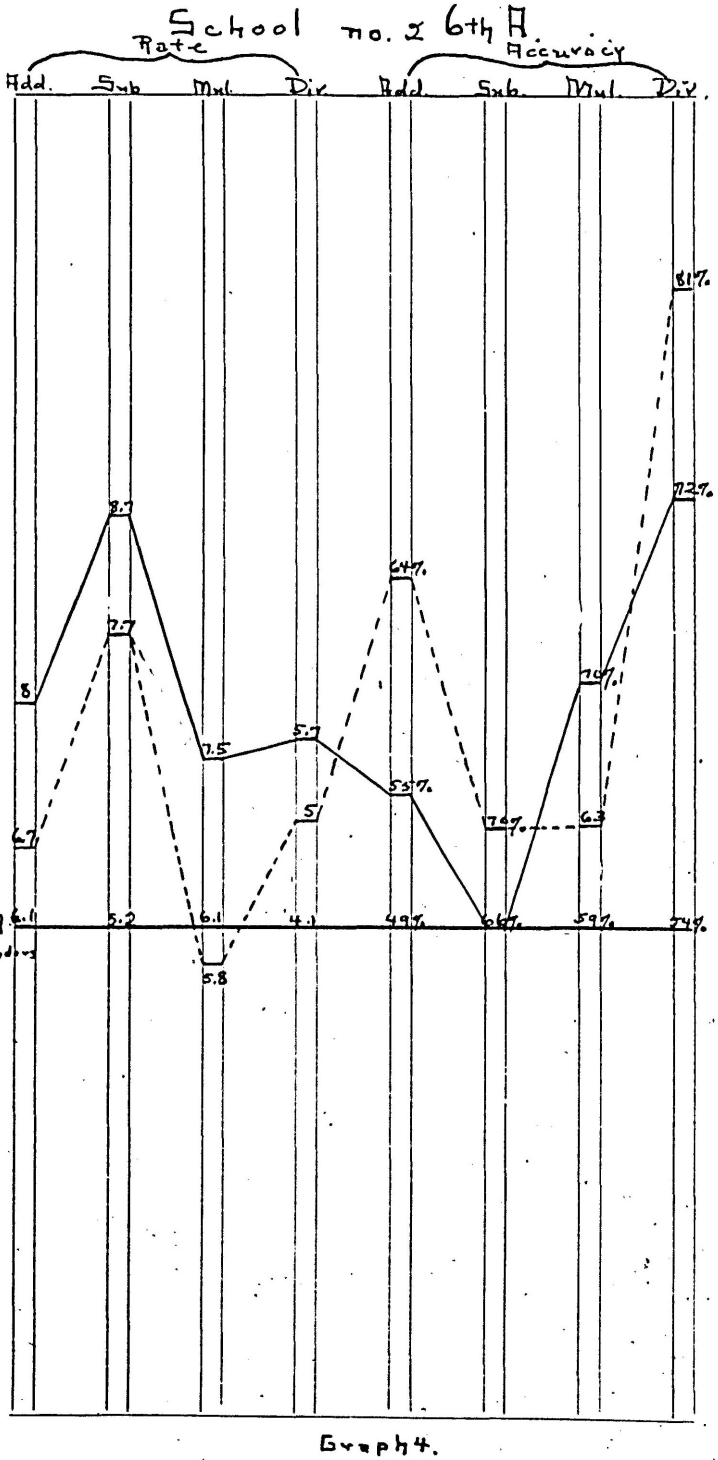
— Median in Test Jan. 1917.
183 Lawrence, Kan. 6th Graders

--- 1st Test Nov. 12, 1917.
16 6th A Pupils.

— 2nd Test Jan. 10, 1918.
16 6th A Pupils.

Graphs.

Used Courtis Material.



Medians.

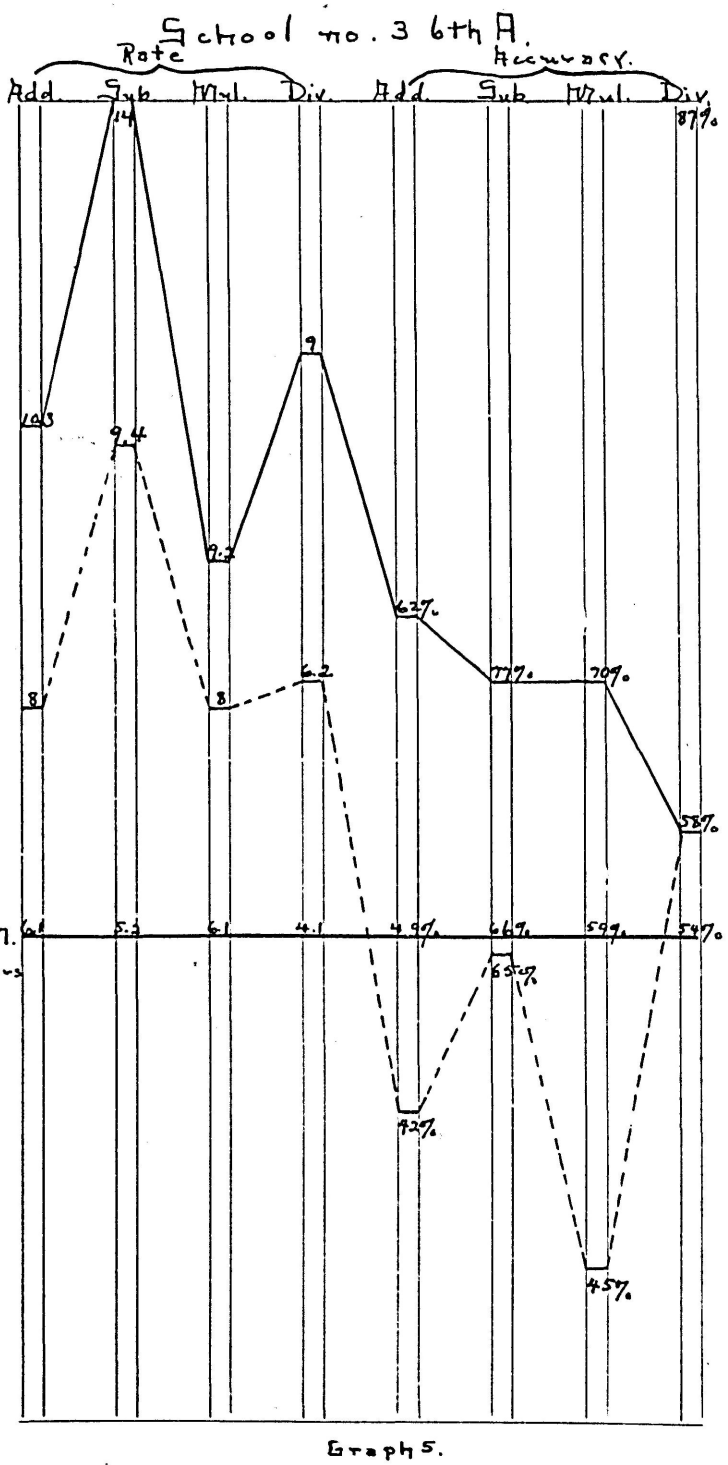
— Median in Test Jan. 1917
183 Lawrence Kan. 6th Grades

--- 1st Test Nov. 12, 1917
17 6th A Pupils.

— 2nd Test Jan. 10, 1918.
17 6th A Pupils.

Graph 4.

Used Studebaker Material.



Medians.

—— Median in Test Jan. 1917.
183 Lawrence, Mass. 6th Graders.

--- 1st Test Nov. 12, 1917.
24 6th A Pupils.

—— 2nd Test Jan. 10, 1918.
24 6th A Pupils.

Graph 5.

Used no Material.

Table 1.

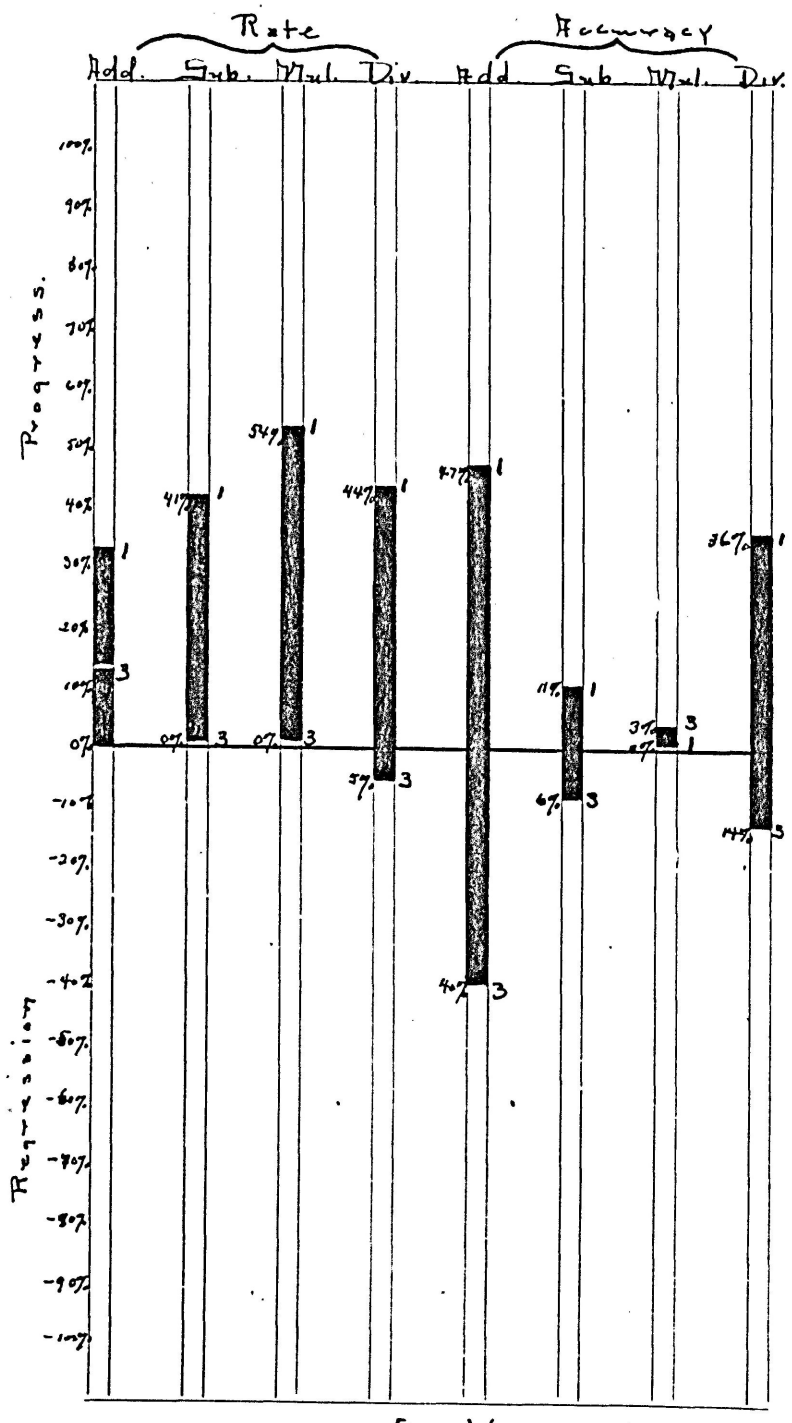
School	No. of Children	Addition				Subtraction				Multiplication				Division			
		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy	
		Req.	Prog.	Req.	Prog.	Req.	Prog.	Req.	Prog.	Req.	Prog.	Req.	Prog.	Req.	Prog.	Req.	Prog.
1	20		33%		47%		41%		11%		54%		0		44%		36%
2																	
3	19		13%		40%		0		6%		0		3%		5%		14%

Percent of Regression or Progress made in 20 days by 6B Classes.

Table 2.

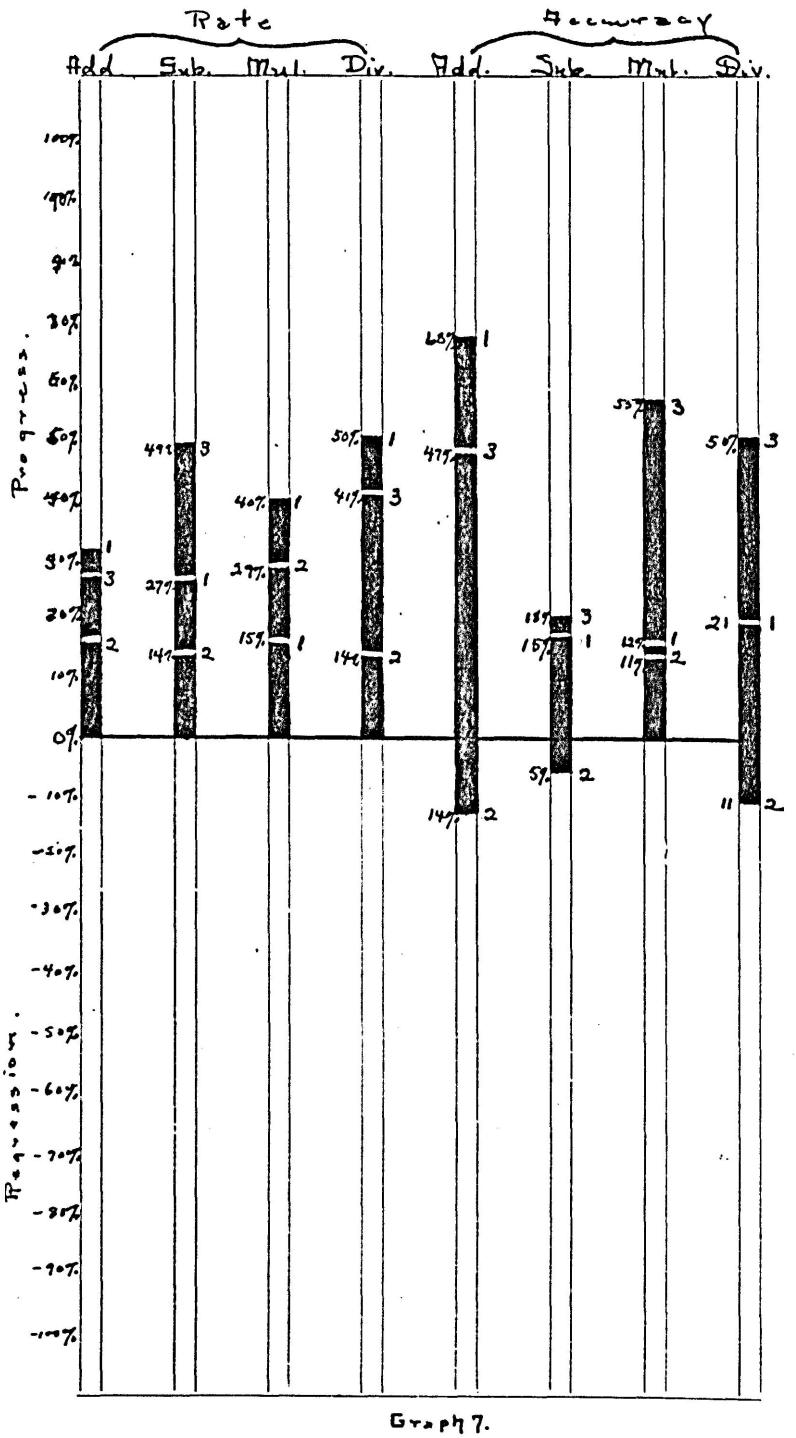
School	No. of Children	Addition				Subtraction				Multiplication				Division			
		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy	
		Req.	Prog.	Req.	Prog.	Req.	Prog.	Req.	Prog.	Req.	Prog.	Req.	Prog.	Req.	Prog.	Req.	Prog.
1	16		30%		68%		27%		15%		40%		12%		50%		21%
2	17		17%		14%		14%		5%		29%		11%		14%		11%
3	24		28%		47%		49%		18%		15%		55%		41%		50%

Percent of Regression or Progress made in 20 days by 6A Classes.



Graph 6.

Percent of Regression or Progress made in 20 days by 6 B Classes 1-3 no. of Schools.



Graph 7.

Percent of Regression or Progress made in 20 days by 6 A Classes. 1-2-3 no. of Schools.

P A R T II.

CHAPTER I.

SEVENTH GRADE RESULTS.

The investigations in the seventh and eighth grades are of particular value as all three Sections of each B and A class in each grade had the same teacher. Variations in the ability of the teacher to drill the four fundamentals in arithmetic do not affect the results in these grades.

As stated in the introduction, Section No. 1 used the Courtis practice material, Section No. 2 the Studebaker material, and Section No. 3 the Regular Dictated Drill.

Tables 1 and 2 compare the medians of each B and A class in the 1st and 2nd trials. These medians were computed with the aid of the regular Courtis Standard Record Sheets.

Graphs 1 to 6 inclusive are made from the data tabulated in Tables 1 and 2. The base line used in the graphs is the median score for 183 Lawrence Kansas 7th Grade children tested by the investigator in January 1917.

Graphs 1, 2 and 3 show that the B classes in all three sections made regressions during the twenty days of drill. Graph 1 shows that the Courtis Section made better medians than the Lawrence medians for 1917. Graph 2 shows the low rate of speed passed by pupils in the Studebaker section. This was not corrected by drill. Graph 3 shows that the Dictated Drill class varied around the 1917 Lawrence medians in the 1st test and did not bring up its score appreciably except in accuracy in addition.

Graphs 4, 5 and 6 show that all three sections of the A class did not possess any greater initial ability than the B class sections of this grade. The Studebaker and Dictated Drill classes made consistent gains in accuracy.

Tables 3 and 4 compare the gains in per cent of the second trial over the first. These gains were computed from tables 1 and 2. Graphs 8 and 9 illustrate the relative proportion of gains in the four fundamentals in each school.

Graph 7 shows that the Sections in the 7th B class did not make large gains in either speed or accuracy. Graph 8 shows that the Sections in the 7th

A class regressed considerably in rate and made large gains in accuracy in multiplication and division.

SUMMARY AND CONCLUSION.

In conclusion, it may be said that graphs 7 and 8 show the following facts in regard to increase in ability to solve the Courtis problems in the fundamentals in the seventh grade.

1. The B and A classes of Section 1 both regressed below their first medians.
2. The B and A classes of Sections 2 and 3 at no time regressed in accuracy.
3. The B class of section 1 only did not make regression in speed.
4. As seen from the following comparison made from Tables 3 and 4, all sections of the B class made a gain.

COMPARISON OF GAINS IN ALL PROCESSES

		Total Gain Speed	Total Gain Accuracy
Courtis Material			
Section 1	Class B	12%	0%
	Class A	-1%	9%
Studebaker Material			
Section 2	Class B	20%	5%
	Class A	0%	29%
No Material but Dictated Drill			
Section 3	Class B	5%	10%
	Class A	-5%	5%

5. All sections of the A class made a gain in accuracy. Thus in the 7th grade, gains in rate and accuracy do not go hand in hand.
6. In the 7th grade, the Studebaker and Dictated Drill accomplished the most in accuracy in both B and A classes.

7. Considering both rate and accuracy together, the Studebaker sections made the largest per cent of gains.

Table 1.

School	No. of Children	Addition				Subtraction				Multiplication				Division			
		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy	
		1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
1	17	10.3	12.3	70%	65%	10.6	11.5	86%	83%	8.7	9	78%	81%	7.4	9	86%	93%
2	21	8.3	9.3	66%	70%	8.7	11.5	76%	83%	7.1	7.8	70%	70%	5.2	3.9	85%	86%
3	26	8.4	8.7	55%	71%	10	8.5	81%	86%	7.8	7.5	60%	60%	7	7.5	77%	85%

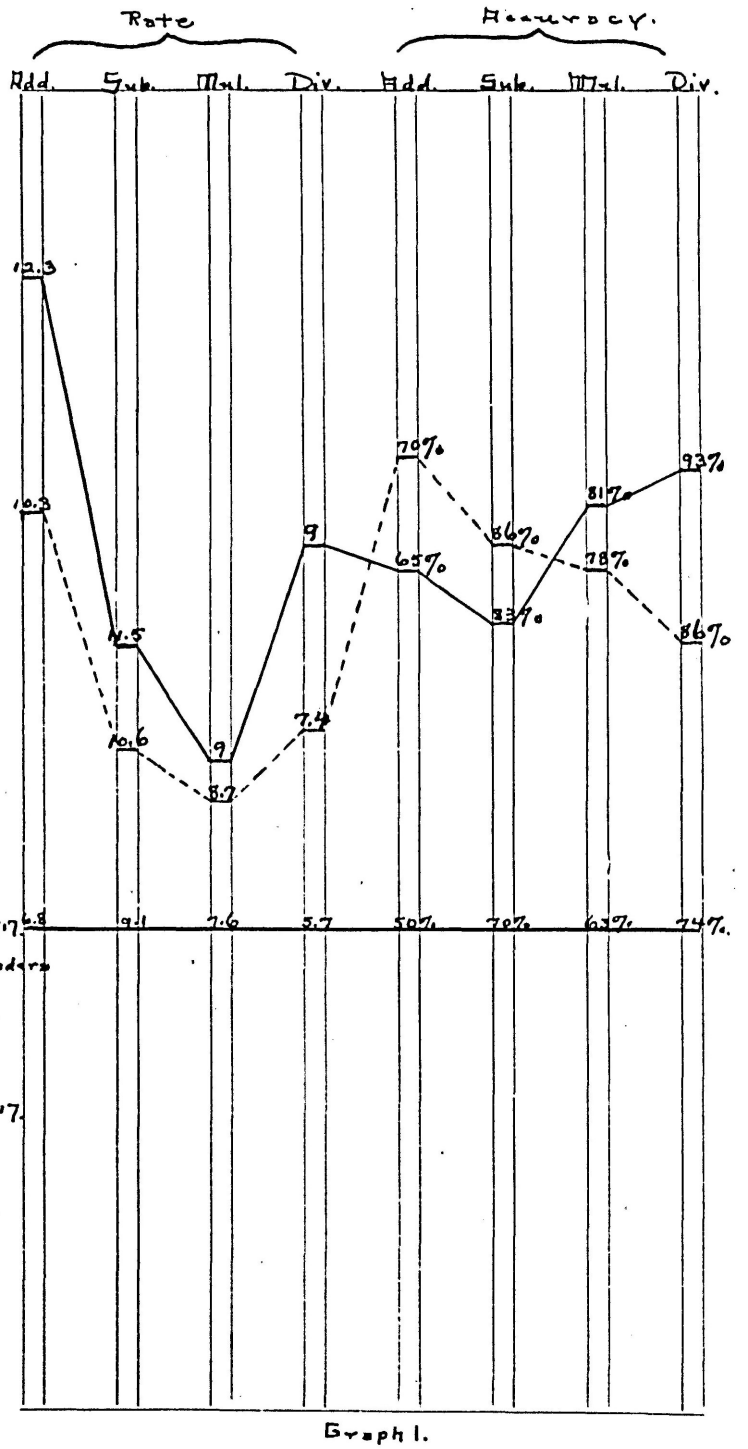
Median Rate and Accuracy - 1st and 2nd Trials for 7B Sections.

Table 2.

School	No. of Children	Addition				Subtraction				Multiplication				Division			
		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy	
		1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
1	13	8.5	7.6	55%	55%	9.5	8.5	82%	76%	6.7	8	60%	63%	5.7	5.6	65%	90%
2	11	8	10	60%	65%	9	8.6	75%	76%	11	8	58%	82%	6	6.5	50%	86%
3	19	9	8.5	57%	60%	11.2	9	80%	82%	8	7.1	72%	80%	7	8	82%	85%

Median Rate and Accuracy - 1st and 2nd Trials for 7A Sections.

Section no. 1, 7th B.



Graph I.

Used Courtis Material.

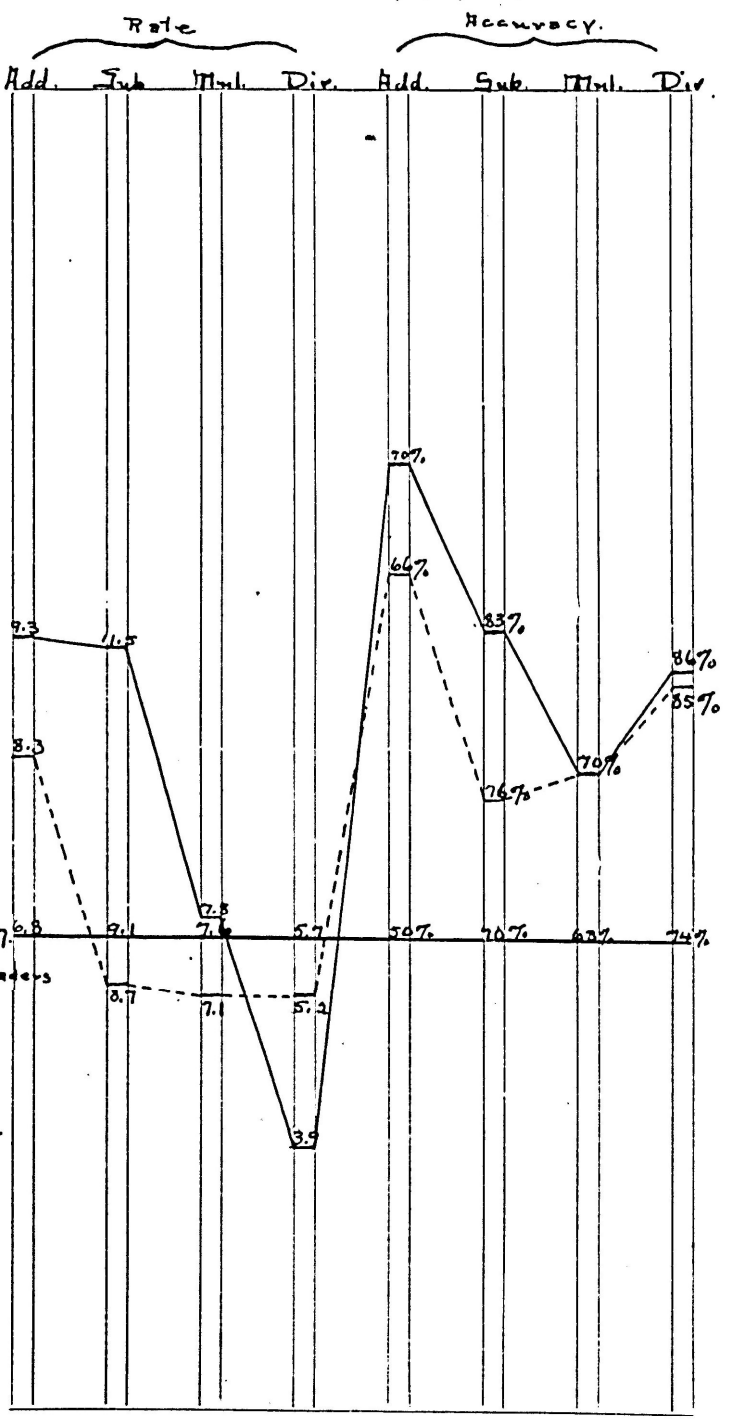
Medians.

— Median in Test Jan. 1917 183 Lawrence Kan. 7th Graders

--- 1st Test Oct. 16, 1917 17 7th B Pupils.

— 2nd Test Dec. 14, 1917 17 7th B Pupils.

Section no. 2, 7th B.



Medians.

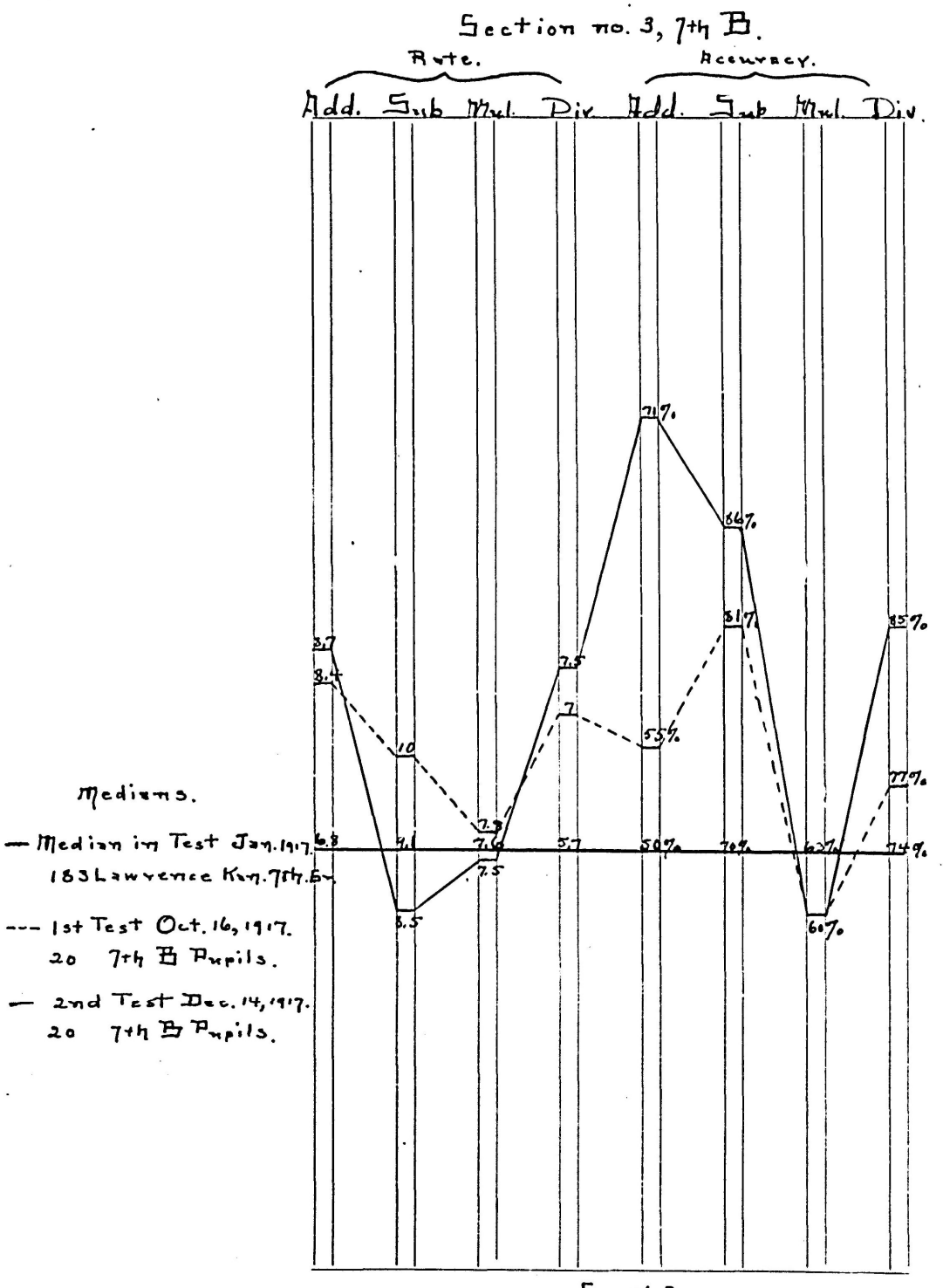
— Median in Test Jan. 1917.
183 Lawrence Kan 7th Graders

--- 1st Test Oct. 16, 1917.
21 7th B Pupils.

— 2nd Test Dec. 14, 1917.
21 7th B Pupils.

Graph 2.

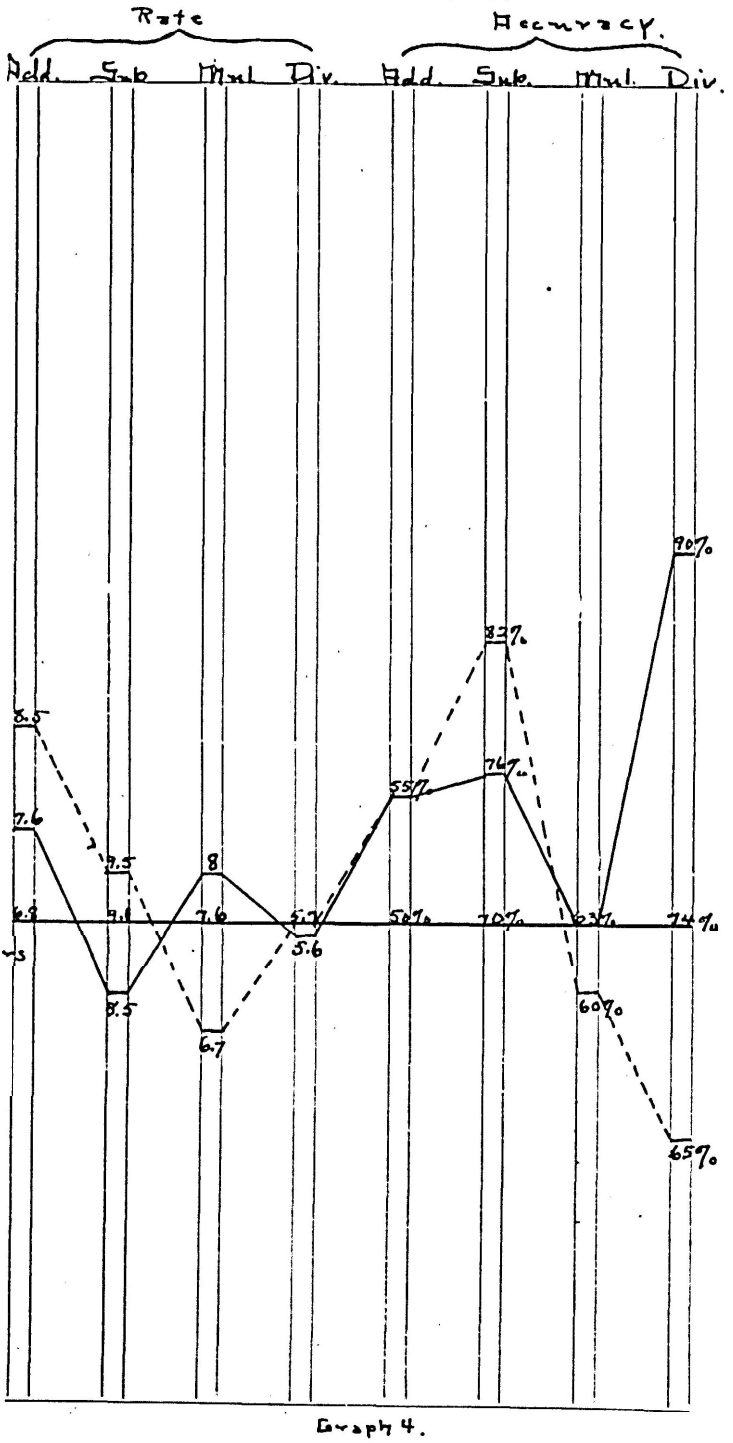
Used Studebaker Material.



Graph 3.

Used no Material.

Section no. 1, 7th A.



Graph 4.

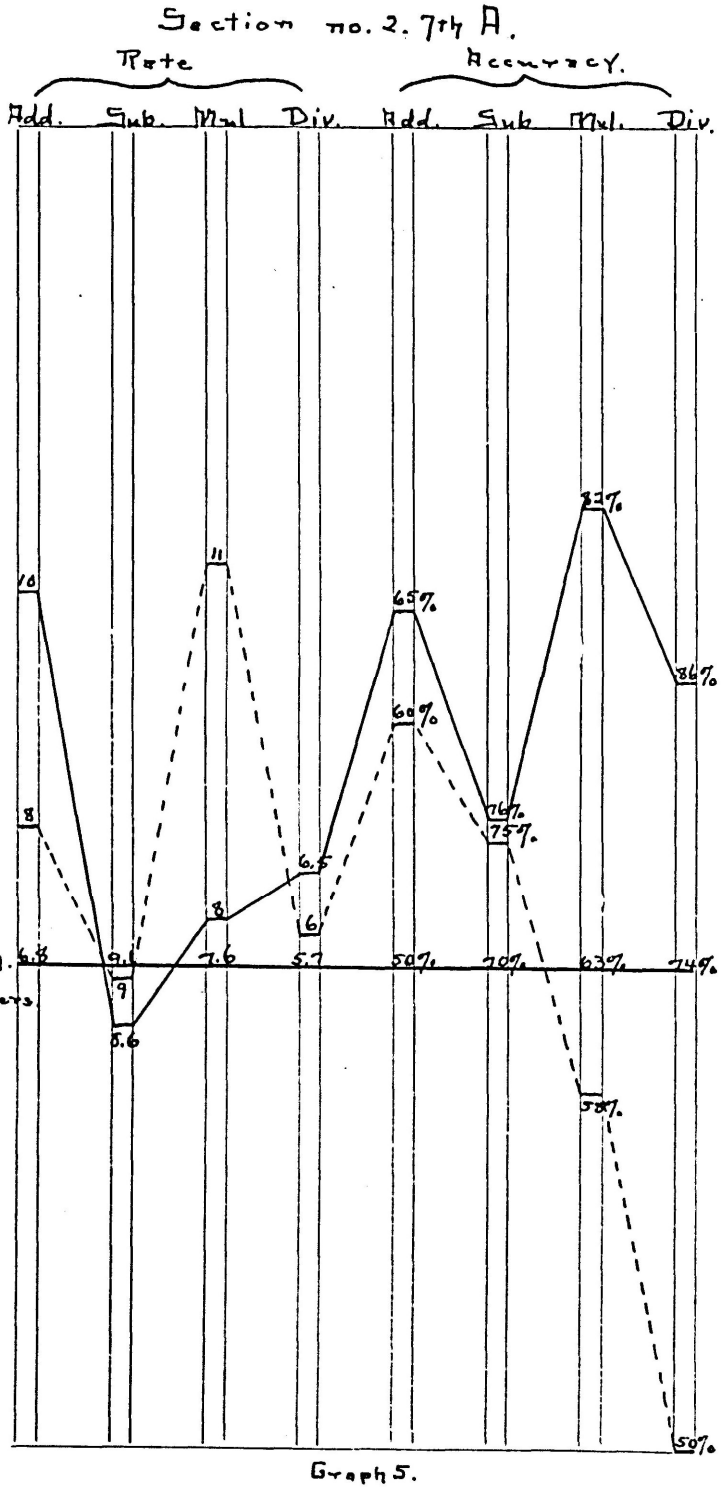
Used Courtis Material.

Medians.

—Median in Test Jan. 1917. 183 Lawrence Key. 7th Graders

---1st Test Oct. 17, 1917. 13 7th B Pupils.

—2nd Test Dec. 14, 1917. 13 7th B Pupils.



Medians.

— Median in Test Jan. 1917. 183 Lawrence Kan. 7th Graders.

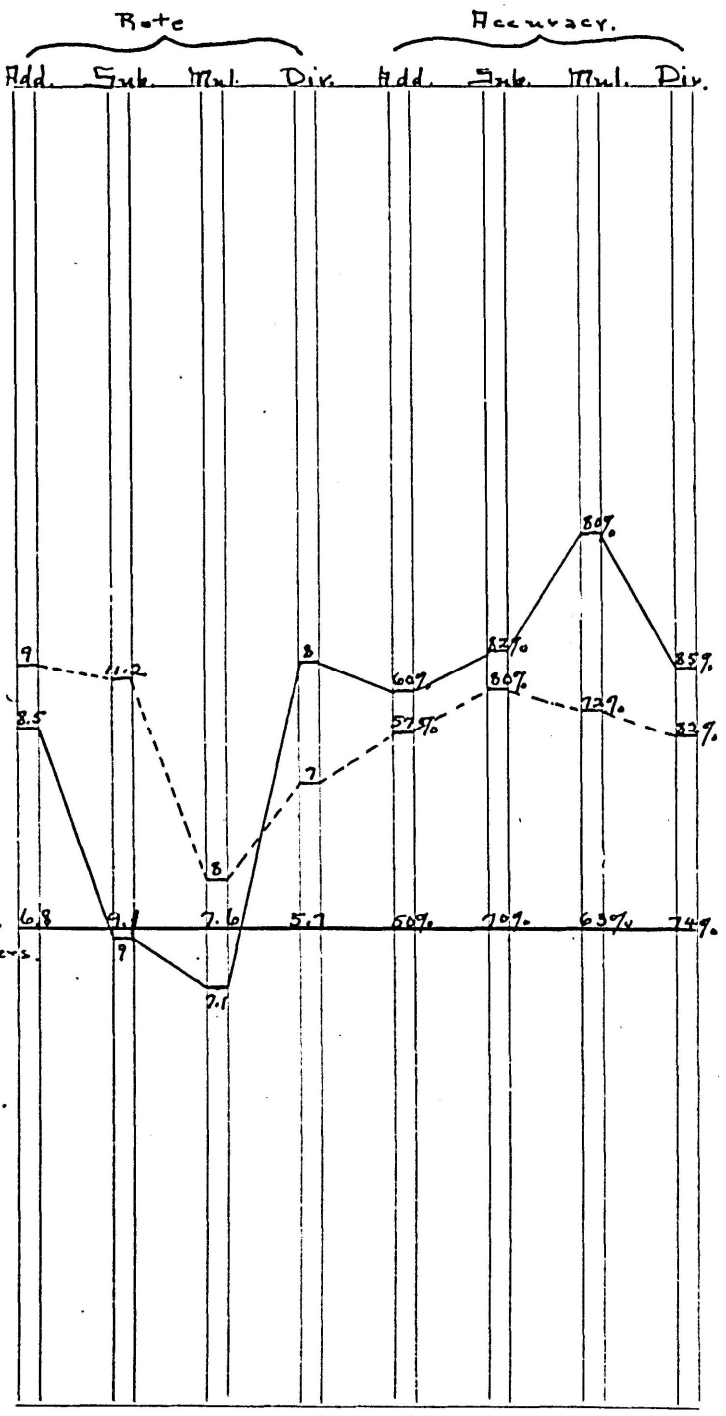
--- 1st Test Oct. 17, 1917. 11 7th A Pupils.

— 2nd Test Dec. 14, 1917. 11 7th A Pupils.

Graph 5.

Used Studebaker Material.

Section no 3, 7th A.



Medians.

—Median in Test Jan. 1917. 183 Lawrence Kan. 7th Graders.

---1st Test Oct. 17, 1917. 19 7th A Pupils.

— 2nd Test Dec. 14, 1917. 19 7th A Pupils.

Graph 6.

Used no Material.

Table 3.

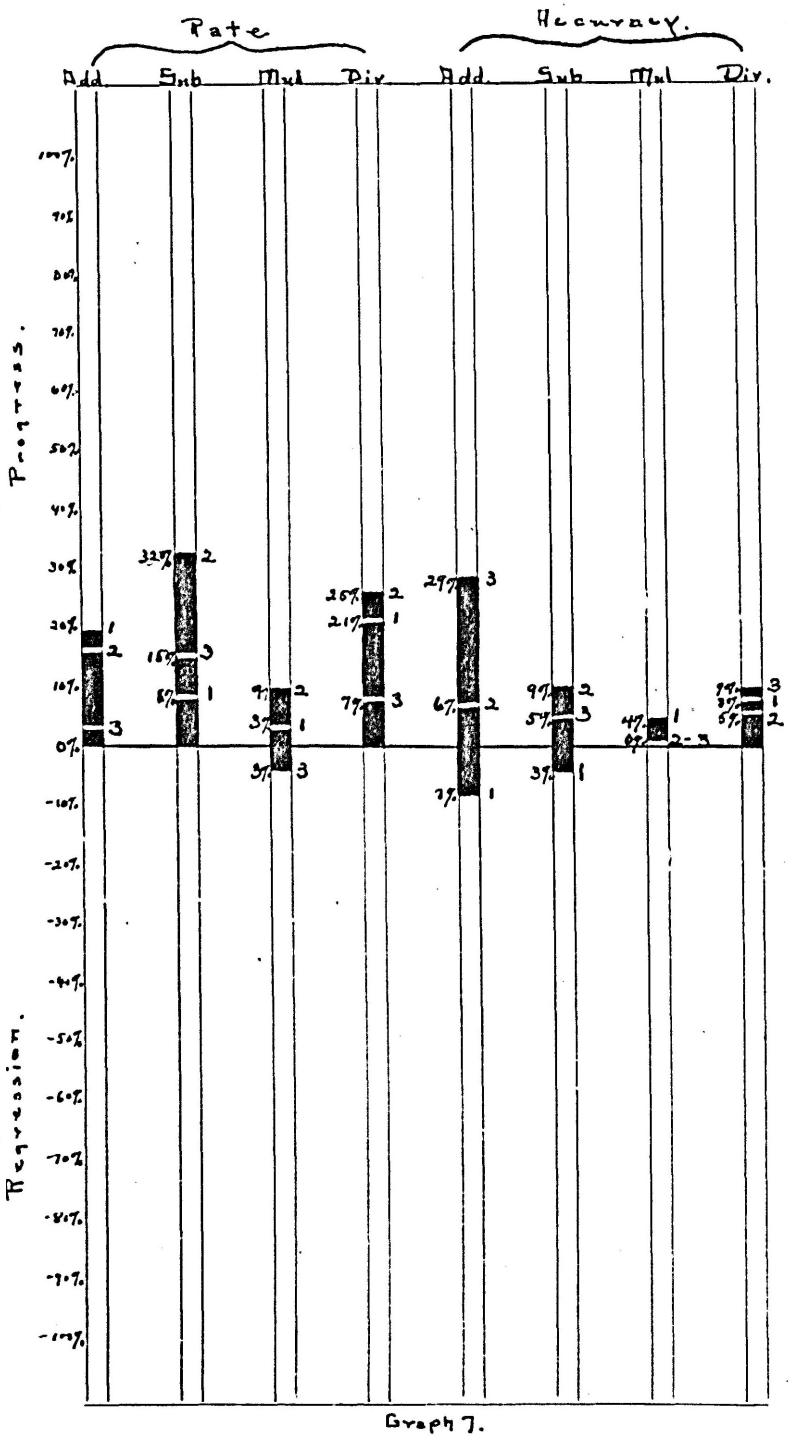
School	No. of Children	Addition				Subtraction				Multiplication				Division			
		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy	
		Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.
1	17		19%	7%			8%	3%			3%		4%		21%		8%
2	21		16%		6%		32%		9%		9%		0%		25%		5%
3	20		3%		29%		15%		5%	3%			0%		7%		9%

Percent of Regression or Progress made in 20 days by 7 B Sections.

Table 4.

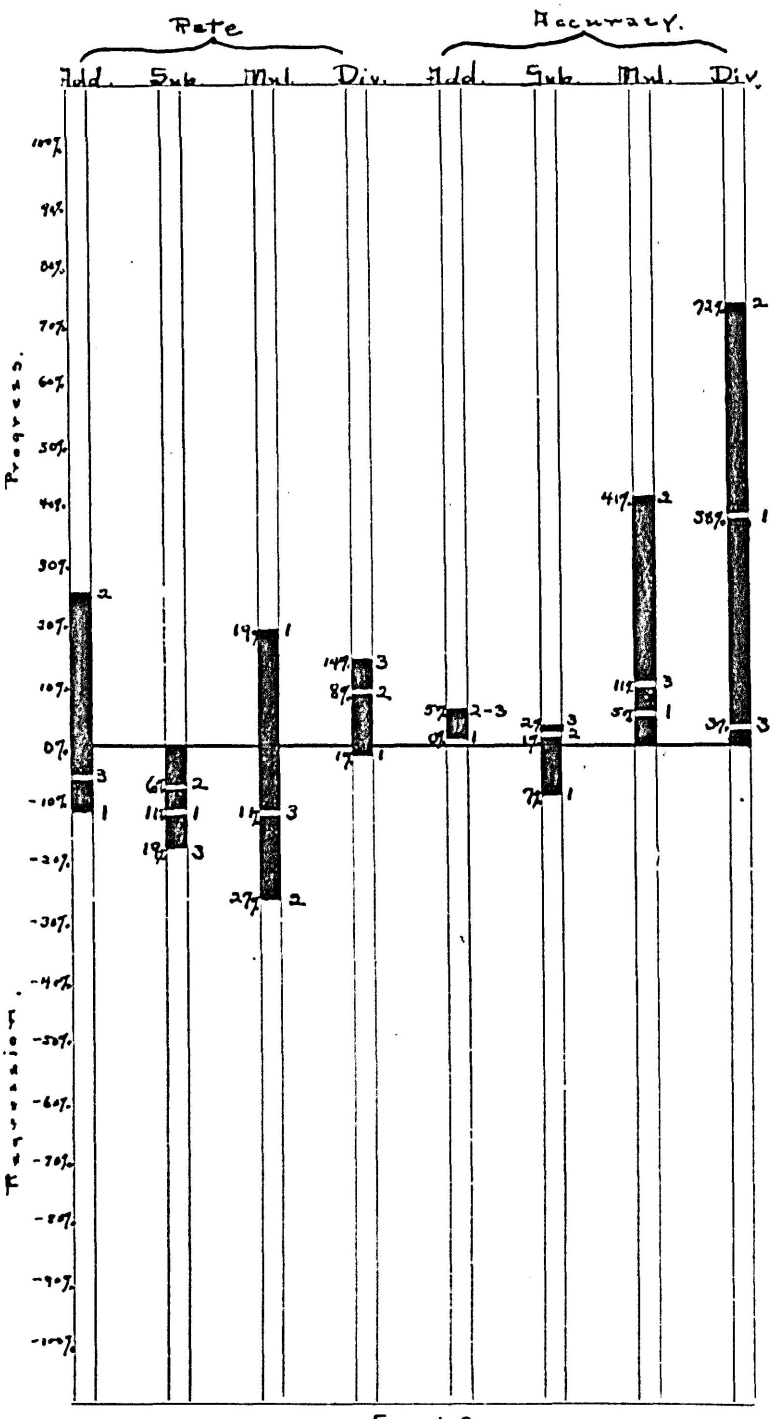
School	No. of Children	Addition				Subtraction				Multiplication				Division			
		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy	
		Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.
1	13	11%			0%	11%		7%			19%		5%	1%			38%
2	11		25%		5%	6%			1%	27%			41%		8%		72%
3	19	5%			5%	19%			2%	11%			11%		14%		3%

Percent of Regression or Progress made in 20 days by 7 A Sections.



Graph 7.

Percent of Regression or Progress made in 20 days by 7 B Classes 1-2-3 no. of Sections.



Graph 8.

Percent of Regression or
Progress made in 20 days
by 7A Classes
1-2-3 no. of Sections.

CHAPTER II.

EIGHTH GRADE RESULTS.

As stated in Part II, Section No. 1 used the Courtis practice material, Section No. 2 the Studebaker material, Section No. 3 the Regular Dictated Drill.

Tables 1 and 2 compare the medians of all three sections in each B and A class in the 1st and 2nd trials. These medians were computed with the aid of the regular Courtis Standard Record Sheets.

Graphs 1 to 6 inclusive, are made from the data tabulated in Tables 1 and 2. The base line used in these graphs is the median score for 137 Lawrence Kansas 8th Grade children tested by the investigator in January 1917.

Graphs 1, 2 and 3 show that in the first test the Courtis Section (Graph 1) made a much lower score than either of the other two sections. Graph 2 shows that the Studebaker section regressed in accuracy in these processes. There is no consistent gain in all processes in any section.

Graphs 4, 5 and 6 show that all three sections

were low in rate in the initial tests. In no section was this materially corrected. Graph 4 shows the fluctuating ability in the Courtis Section. Graphs 5 and 6 show consistent gains made by the Studebaker and Dictated Drill sections in accuracy.

Tables 3 and 4 compare the gains in per cent of the second trials over the first. These gains were computed from Tables 1 and 2. Graphs 7 and 8 illustrate the relative proportion of gains in the four fundamentals for each school. Graph 8 shows that the Courtis Section made the greatest amount of regression.

SUMMARY AND CONCLUSION

In conclusion, it may be said that graphs 5 and 6 show the following facts in regard to increase in ability to solve the Courtis problems in the fundamentals in the eighth grade.

1. Section 1, B class made gains in rate in three processes.
2. Section 3, B class made gains in accuracy in three processes.
3. Section 1, A class made a large per cent of regression in accuracy.

4. Section 2, A class made the largest per cent of gain in accuracy.

5. As seen from the following comparison made from tables 3 and 4, Section 3 made the largest average gain in all processes.

COMPARISON OF GAINS IN ALL PROCESSES

		Total Gain Speed	Total Gain Accuracy
Courtis Material			
Section 1	Class B	12%	10%
	Class A	16%	-19%
Studebaker Material			
Section 2	Class B	4%	-4%
	Class A	10%	13%
No Material but Dictated Drill			
Section 3	Class B	6%	3%
	Class A	8%	6%

6. The Courtis section regressed 19% in accuracy as an average in all processes.

7. The Studebaker and Dictated Drill Sections made about the same average gain in speed.
8. The Dictated Drill sections made the largest per cent of gain in accuracy of any of the three sections.

Table 1.

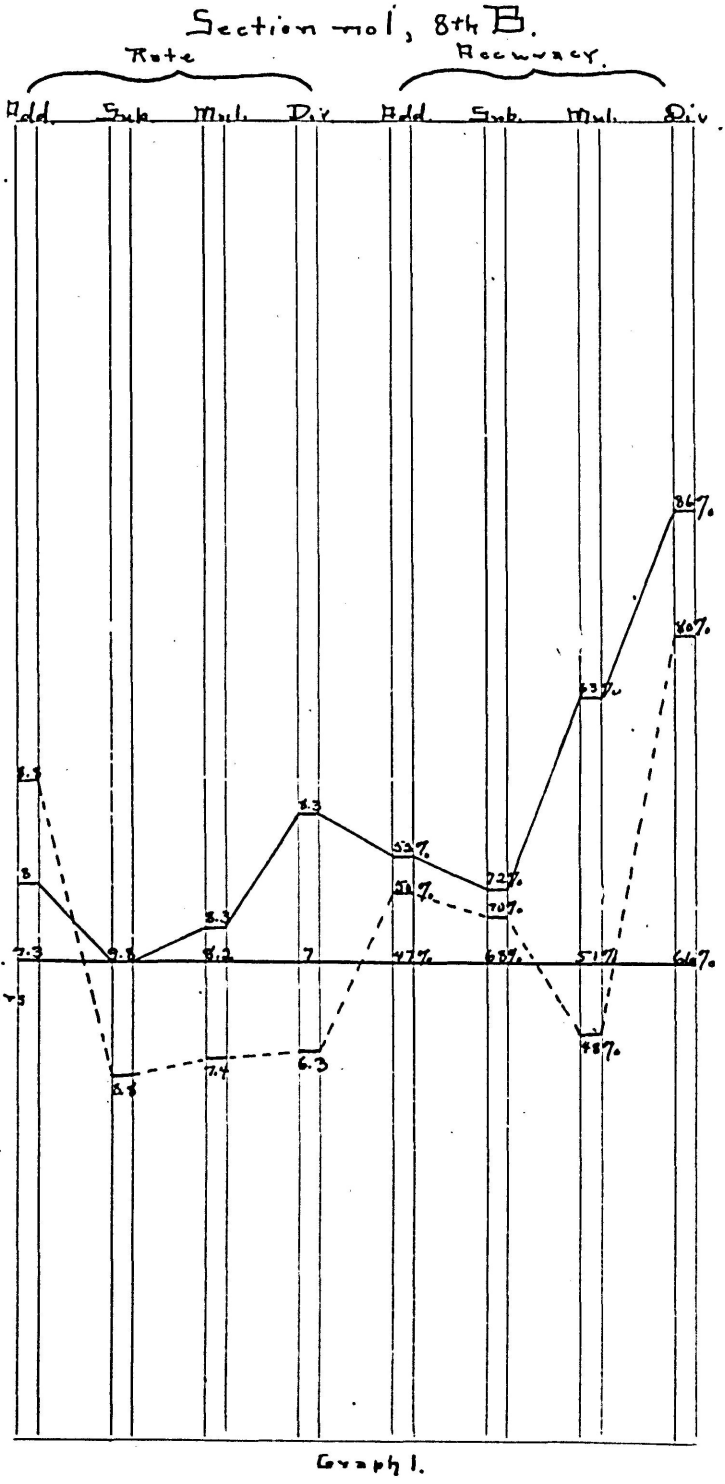
School	No. of Children	Addition				Subtraction				Multiplication				Division			
		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy	
		1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
1	21	8.8	8	50%	52%	8.8	9.8	70%	72%	7.4	8.5	48%	63%	6.3	8.3	80%	86%
2	20	9.2	11	56%	56%	10.2	10.5	72%	73%	9.1	9.2	74%	62%	8	7.8	77%	75%
3	20	9.3	11	50%	53%	9.8	10	75%	85%	9.3	10	80%	63%	8.5	8.6	90%	100%

Median Rate and Accuracy - 1st and 2nd Trials for 8B Sections.

Table 2.

School	No. of Children	Addition				Subtraction				Multiplication				Division			
		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy	
		1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
1	16	7.2	9.7	62%	40%	9.6	9.3	68%	58%	7.8	7.5	50%	55%	5	7	75%	60%
2	17	7	7.3	50%	56%	8.3	9	68%	76%	7.4	8.2	57%	60%	5.3	6.3	70%	80%
3	14	9	10	55%	60%	7.5	9.6	76%	80%	8	7	65%	70%	6	6.5	80%	86%

Median Rate and Accuracy - 1st and 2nd Trials for 8A Sections.



Medians.

— Medians in Test Jan. 1917.
137 Lawrence Jun. 8th Graders

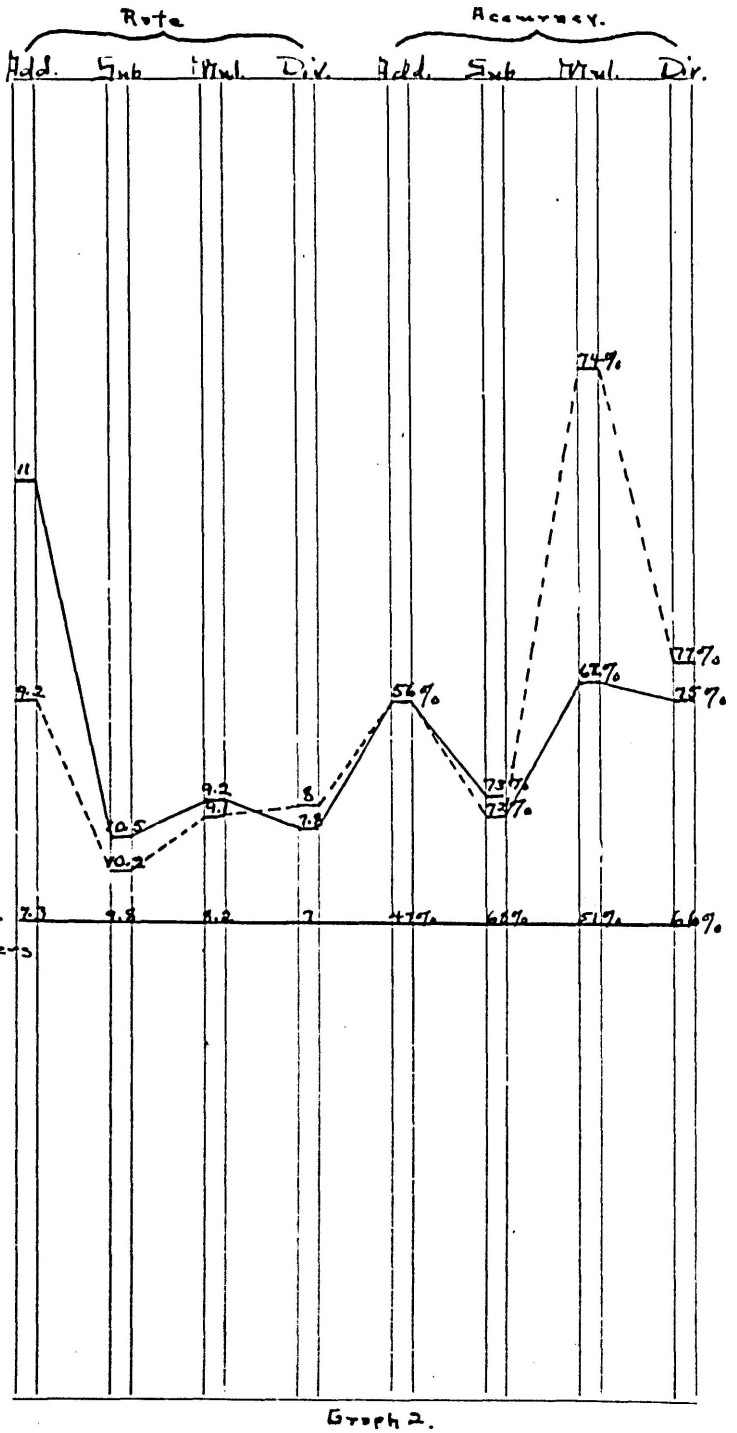
--- 1st Test Oct. 16, 1917.
21 8th B Pupils.

— 2nd Test Jan. 4, 1918.
21 8th B Pupils.

Graph 1.

Used Courtis Material.

Section no. 2, 8th B.



Medians.

— Medians in Test Jan. 1917. 137 Lawrence Kan. 8th Grades.

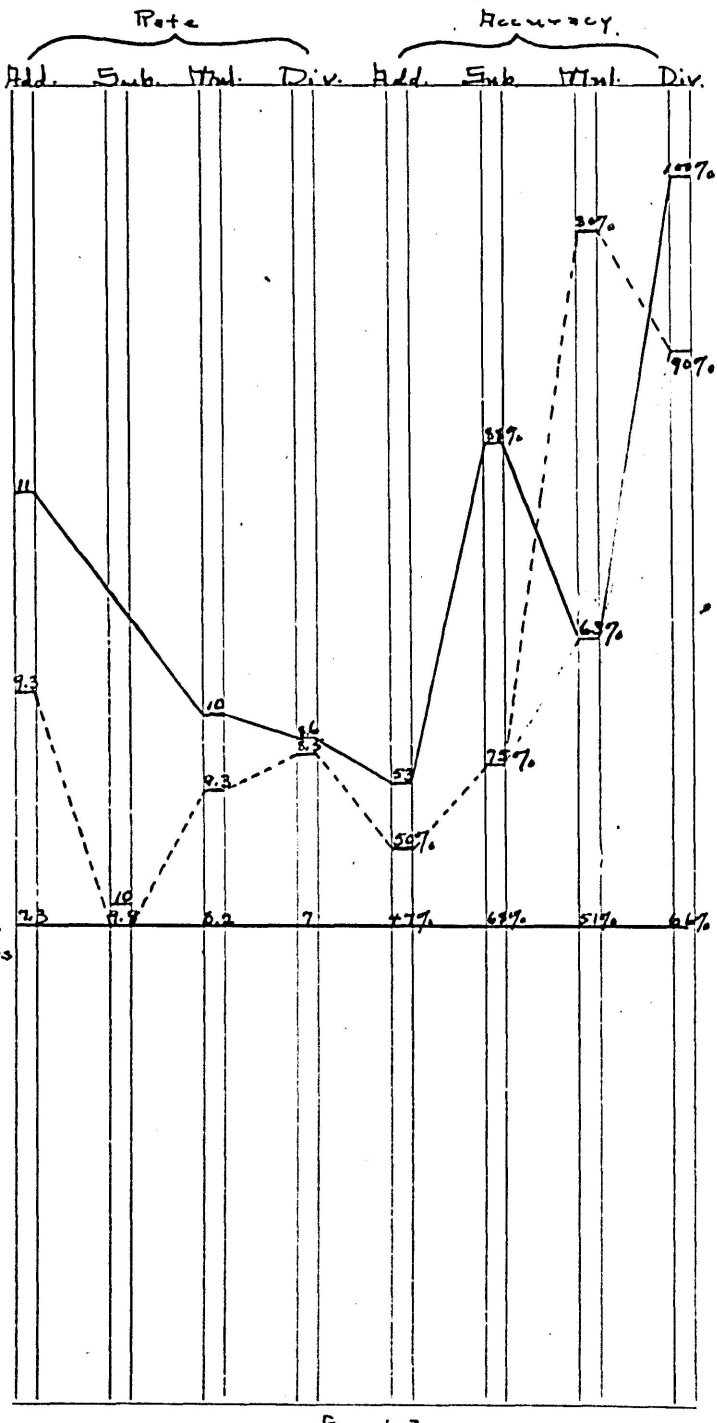
--- 1st Test Oct. 16, 1917. 20 8th B. Pupils.

— 2nd Test Jan. 4, 1918. 20 8th B Pupils.

Graph 2.

Used Studebaker Material.

Section no. 3 8th B.



Medians.

— Medians in Test Jan. 1917.
137 Lawrence Kan. 8th Graders

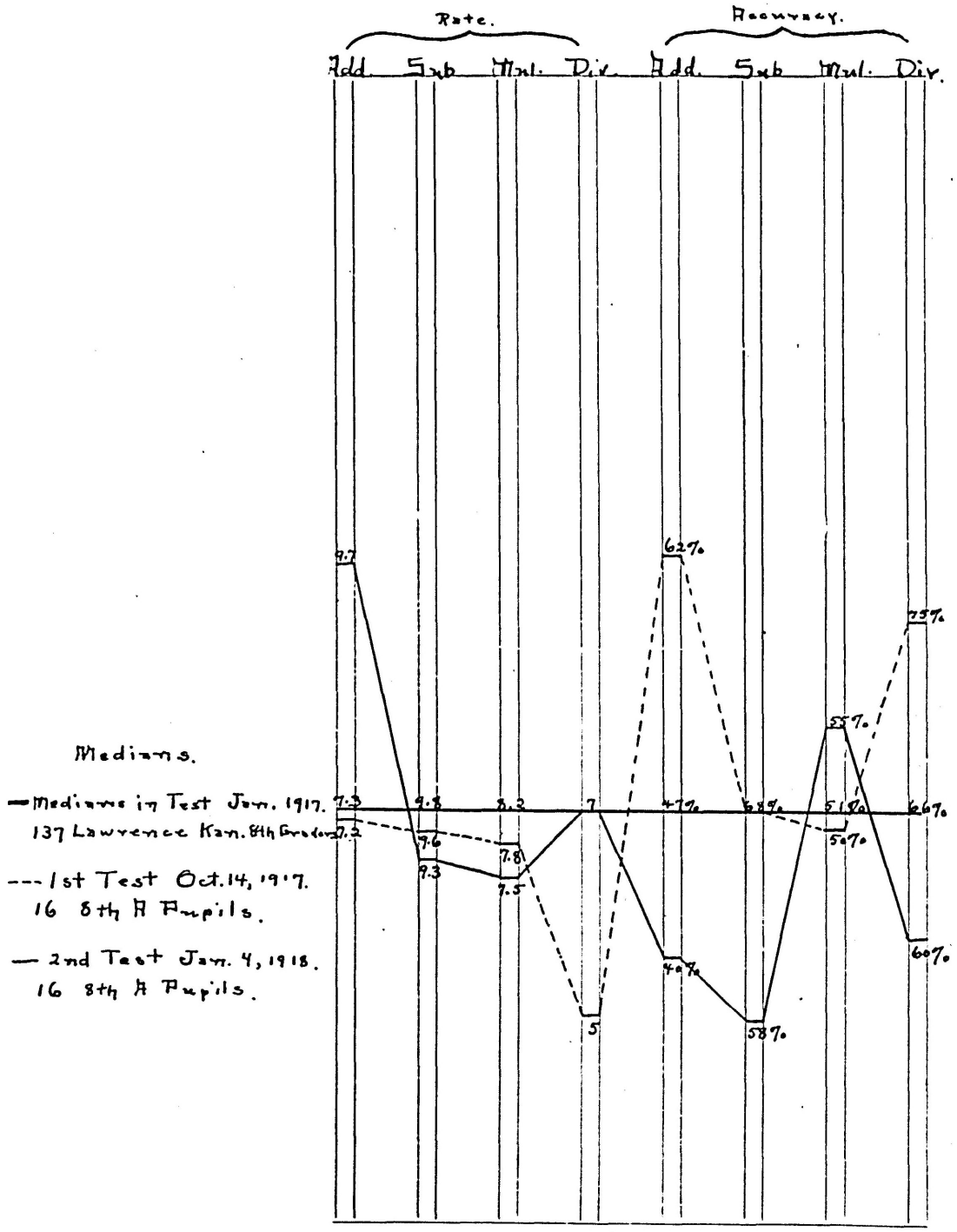
--- 1st Test Oct. 16, 1917
20 8th B Pupils.

— 2nd Test Jan. 4, 1918.
20 8th B Pupils.

Graph 3.

Used no Material.

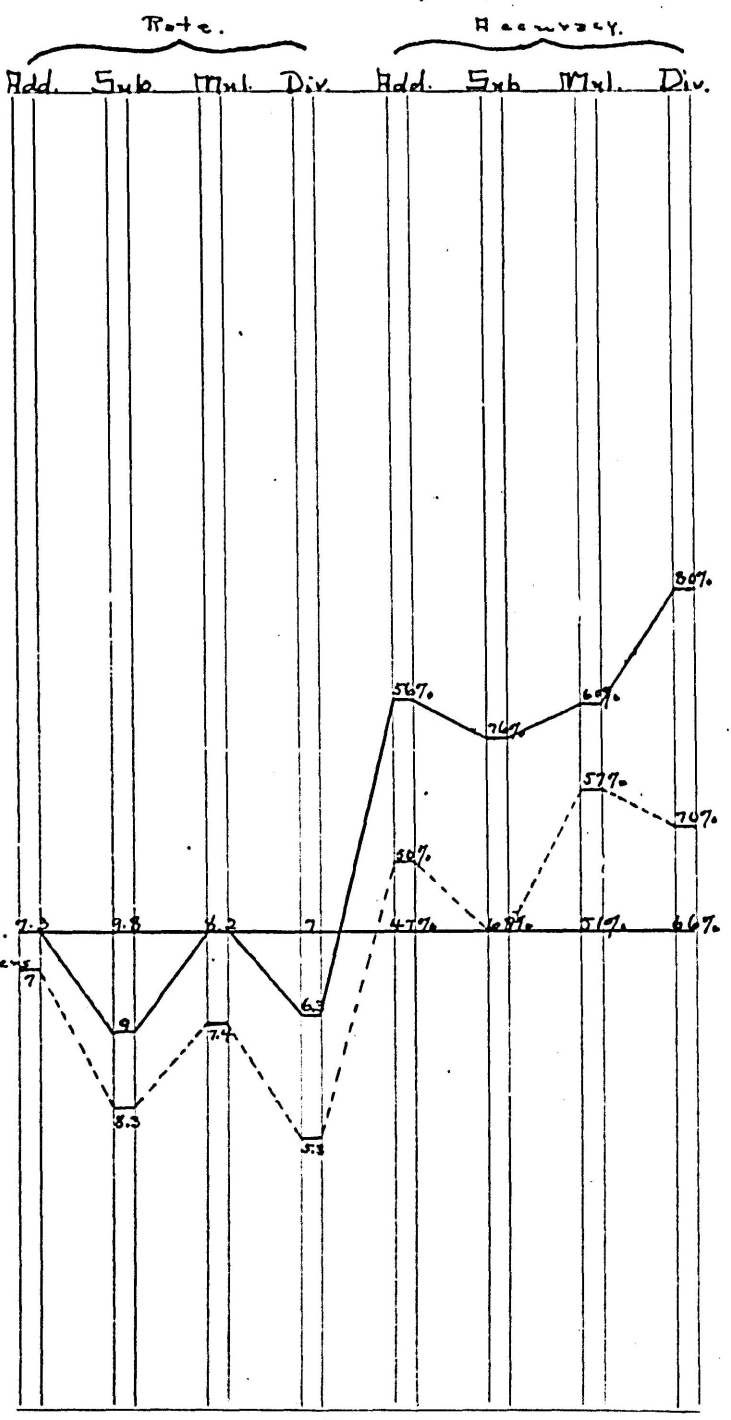
Section no. 1, 8th A.



Graph 4.

Used Courtis Material.

Section no. 2, 8th A.



Medians.

— Medians in Test Jan. 1917. 137 Lawrence Kan. 8th Graders.

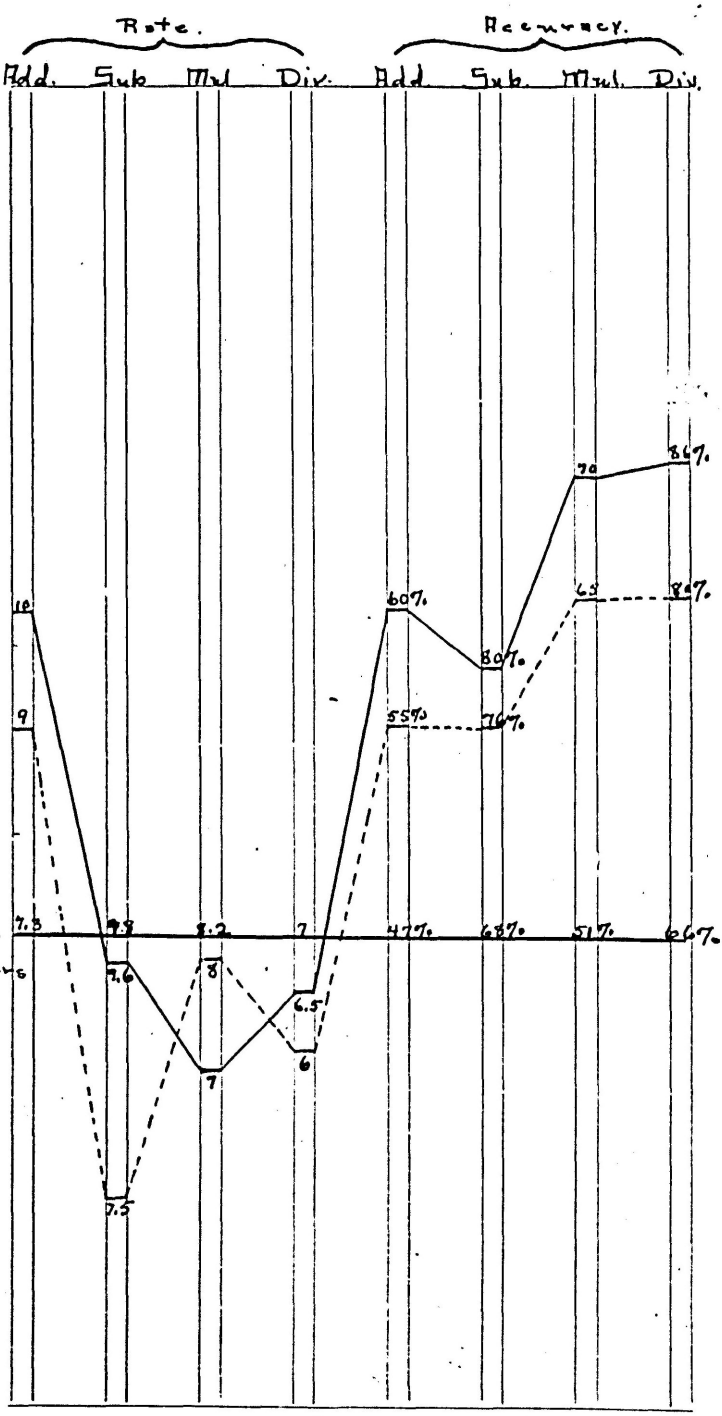
--- 1st Test Oct. 14, 1917. 17 8th A Pupils.

— 2nd Test Jan. 4, 1918. 17 8th A Pupils.

Graph 5.

Used Studebaker Material.

Section no. 3, 8th A.



Medians.

—Medians in Test Jan. 1917. 137 Lawrence Kan. 8th Graders

---1st Test Oct. 14, 1917. 14 8th A Pupils.

— 2nd Test Jan. 4, 1918. 14 8th A Pupils.

Graph 6.

Used no Material.

Table 3.

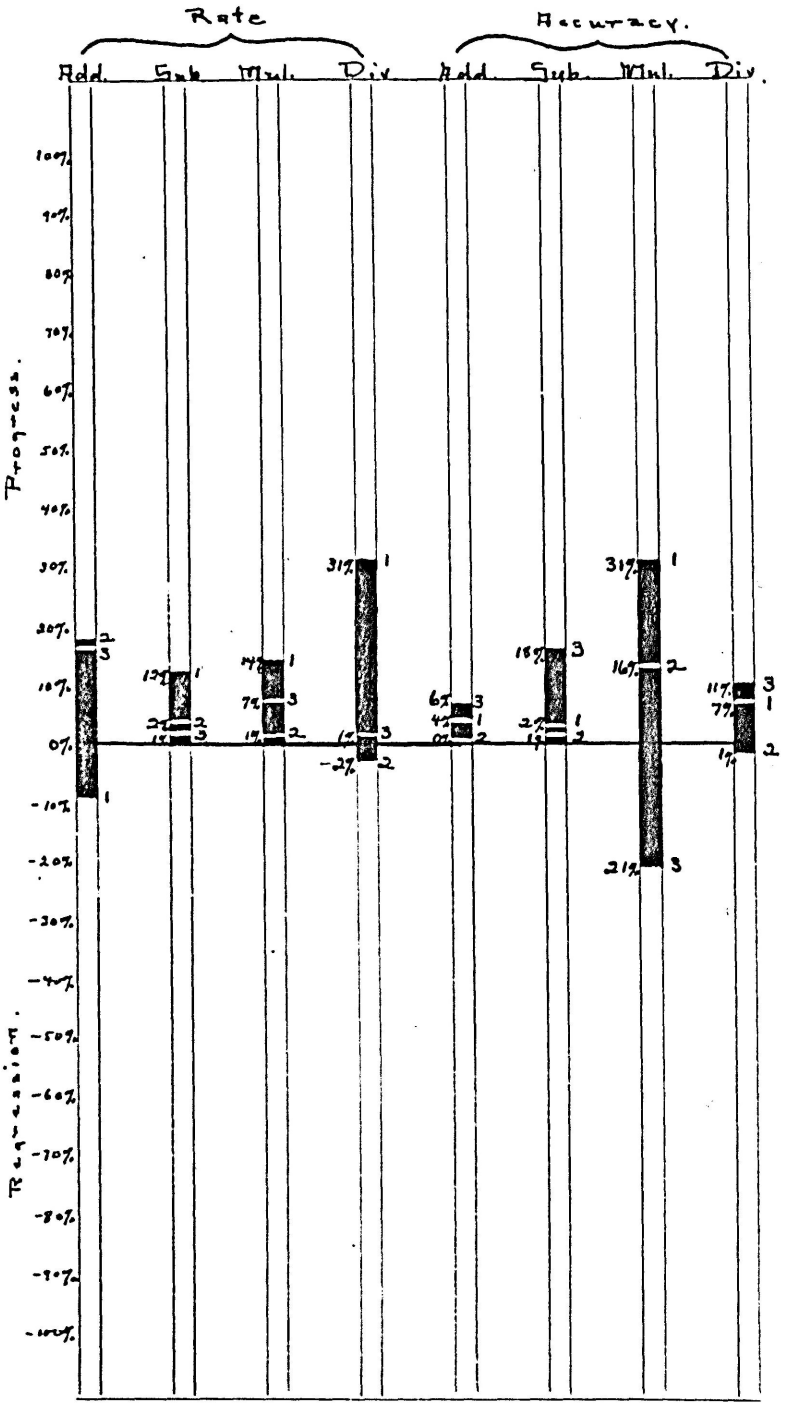
School	No. of Children	Addition				Subtraction				Multiplication				Division			
		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy	
		Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.
1	21	9%			4%		12%		27%		14%		31%		31%		7%
2	20		18%		0%		2%		17%		17%	16%		2%		1%	
3	20		17%		6%		1%		18%		7%	21%			1%		11%

Percent of Regression or Progress made in 20 days by 8B Sections.

Table 4.

School	No. of Children	Addition				Subtraction				Multiplication				Division			
		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy		Rate		Accuracy	
		Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.	Reg.	Prog.
1	16		34%	55%		3%		14%		4%			10%		40%	20%	
2	17		4%		12%		8%		11%		10%		5%		19%		14%
3	14		11%		9%		28%		5%	12%			7%		8%		7%

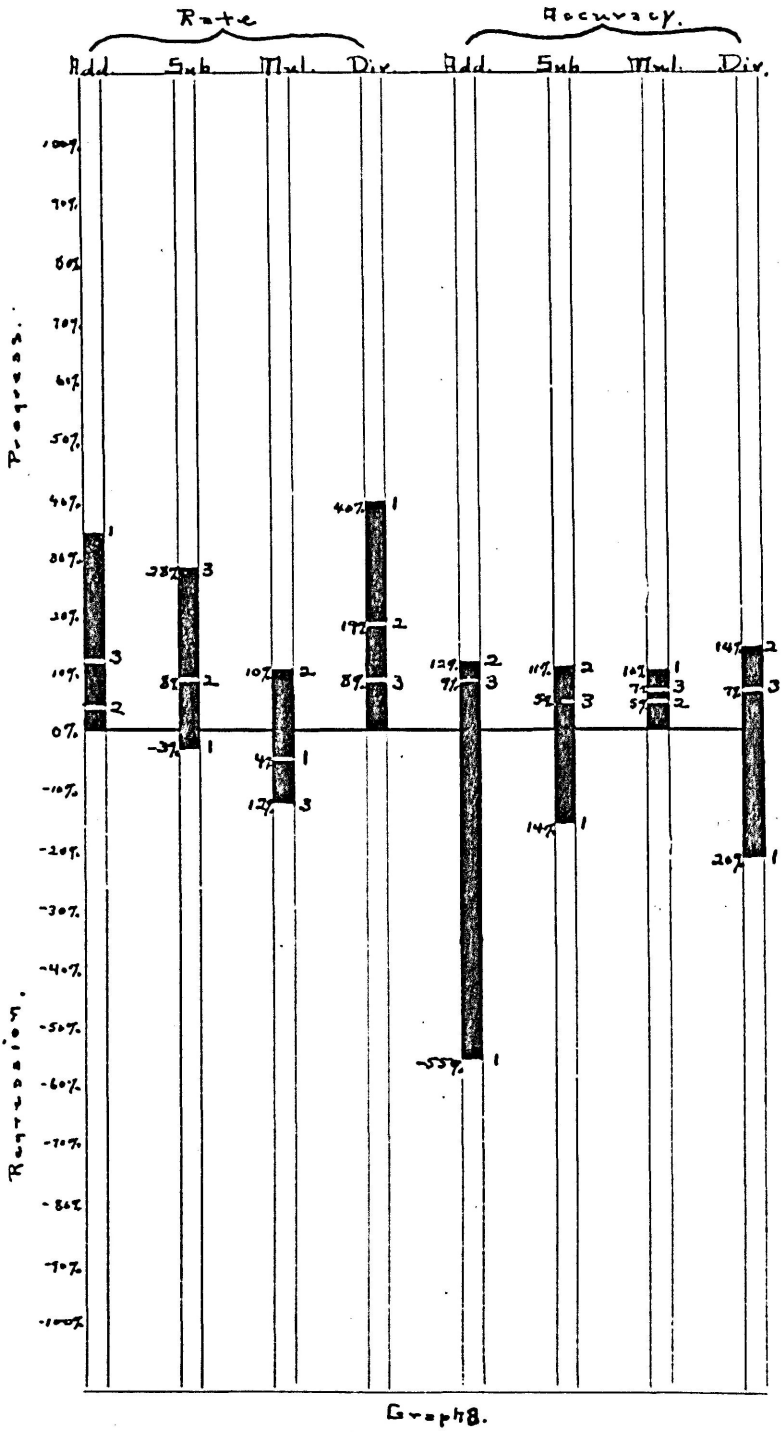
Percent of Regression or Progress made in 20 days by 8A Sections.



Graph 7.

Percent of Regression or Progress made in 20 days by 8 B Sections.

1-2-3 no. of Sections.



Graph 8.

Percent of Regression or Progress made in 20 days by 8 A Sections 1-2-3 no. of Sections.

S U M M A R Y.

The completed tabulations for the 4th, 5th, 6th, 7th and 8th grades show the following average per cent of gain for all classes in each of the three forms of drill.

	Average Gain in Rate All 4 processes			Average Gain in Accuracy All 4 processes		
	Cour.	Stude.	Dict.	Cour.	Stude.	Dict.
4th B Class		26%	8%		55%	38%
4th A "		33%	48%		38%	89%
5th B Class	28%	11%	4%	54%	27%	16%
5th A "	29%		8%	24%		10%
6th B Class	43%		-2%	23%		-14%
6th A "	36%	18%	33%	29%	-4%	42%
7th B Class	12%	20%	5%	0%	5%	10%
7th A "	-1%	0%	-5%	9%	29%	5%
8th B Class	12%	4%	6%	10%	-4%	3%
8th A "	16%	10%	8%	-19%	13%	6%

From the foregoing table it will be seen that the Dictated Drill classes accomplished a greater per cent of gain than either of the other two forms of drill in,

1. 4th A Class (Rate and Acc)
2. 6th A Class (Acc.)
3. 7th B Class (Acc.)

In the 4th A and 6th A classes the large per cent of gain was due to a continued growth in nearly all processes. In the 7th B class, the gain was small and due almost wholly to the large per cent of gain in Addition.

From the foregoing table, it will be seen that the Studebaker Drill classes accomplished a greater per cent of gain than either of the other two forms of drill in,

1. 4th B Class (Rate and Acc.)
2. 7th B Class (Rate)
3. 7th A Class (Acc.)
4. 8th A Class (Acc.)

The large per cent of gain in 4th B was due to such a large gain in Division, from 0 problems to 3.6 in rate and from 0% in accuracy to 35%. The large per cent of gain in rate in the 7th B section was due to the large

per cent of gain in rate in Subtraction. The large per cent of gain in accuracy in the 7th A was due to a gain of from 50% to 86% in accuracy in Division.

From the foregoing table, it will be seen that the Courtis Drill classes accomplished a greater per cent of gain than either of the other two forms of drill in,

1. 5th B Class (Rate and Acc.)
2. 5th A Class (Rate and Acc.)
3. 6th B Class (Rate and Acc.)
4. 6th A Class (Rate)
5. 8th B Class (Rate and Acc.)
6. 8th A Class (Rate)

The larger per cent of gain in the 5th and 6th grades is due to a very consistent increase in ability in all processes. This is very significant as it shows the value of the Courtis practice material in developing abilities in the fundamentals equally.

The 4th, 5th and 6th grades made larger per cents of gain than the 7th or 8th grade classes.

The Courtis classes made the most consistent gains in all processes.

The Courtis classes made gains in both rate and accuracy in four classes and in rate only in two classes.

The Courtis material was found to be giving better results than the Studebaker or Dictated Drills in the four fundamentals in arithmetic.

GENERAL SUGGESTIONS

The 5th and 6th Grade classes show a significant point in the use of the three kinds of drill. The Courtis material brought a larger per cent of gain for these classes than for any other. The fourth grade pupils seem to be able to make a large per cent of gain without material. Children of this age possibly ought not to work under time pressure such as the Courtis or Studebaker Practice Material demands. In the 7th and 8th grades, the practice material seems to be made up of too simple combinations. Pupils of this age know their simple number combinations. They need short drill periods with longer problems involving more concentrated attention.

In the 5th and 6th grades, however, the practice material is ideal. The pressure of time, the gradual difficulty of the problems and the novelty of the material stimulate pupils of this age into concentrated attention.

As a result of this study, Superintendent Raymond

A. Kent can place very profitably the boxes of materials, Studebaker or Courtis, in all the 5th and 6th Grades of his school system. He can advise 4th grade teachers to continue to give dictated drill problems on the shortest and simplest forms of combinations. He can advise the 7th and 8th grade teachers to continue short drill periods on long problems in the four fundamentals in arithmetic.

Measure the efficiency of the entire school, not the individual ability of the few.

KANSAS STATE NORMAL SCHOOL

Research Tests in Arithmetic

Test No. 1 Addition

Series B Form 1

SCORE
No. Attempted 6
No. Right 5

You will be given eight minutes to find the answers to as many of these addition examples as possible. Write the answers on this paper directly underneath the examples. You are not expected to be able to do them all. You will be marked for both speed and accuracy, but it is more important to have your answers right than to try a great many examples.

927	297	136	486	384	176	277	837
379	925	340	765	477	783	445	882
756	473	988	524	881	697	682	959
837	983	386	140	266	200	594	603
924	315	353	812	679	366	481	118
110	661	904	466	241	851	778	781
854	794	547	355	796	535	849	756
965	177	192	834	850	323	157	222
344	124	439	567	733	229	953	525

6096 4749 4285 4949 5217 4160

537	664	634	572	226	351	428	862
695	278	168	253	880	788	975	159
471	345	717	948	663	705	450	383
913	921	142	529	819	174	194	451
564	787	449	936	779	426	666	938
932	646	453	223	123	649	742	433
559	433	924	358	338	755	295	599
106	464	659	676	996	140	187	172
228	449	432	122	303	246	281	152

677	223	186	275	432	634	547	588
464	878	478	521	876	327	197	256
234	682	927	854	571	327	685	719
718	399	516	939	917	394	678	524
838	904	923	582	749	807	456	969
293	353	553	566	495	169	393	761
423	419	216	936	250	491	525	113
955	756	669	472	833	885	240	449
519	314	409	264	318	403	152	122

Name Marion Decker, (BOY OR GIRL) Wa, Age last birthday 11

School Pinckney Grade 6 B Room 8

City Fairview State Kans. Date Feb. 6, 19[illegible]

Measure the efficiency of the entire school, not the individual ability of the few.

Arithmetic. Test No. 2. Subtraction

Series B. **Form 1**

SCORE 7
No. Attempted .....
No. Right 4

You will be given four minutes to find the answers to as many of these subtraction examples as possible. Write the answers on this paper directly underneath the examples. You are not expected to be able to do them all. You will be marked for both speed and accuracy, but it is more important to have your answers right than to try a great many examples.

107795491 77197029 30598462	75088824 57406394 17682530 ✓	91500053 19901563 71598490	87939983 72207316 15732667
160620971 80361837 80259135 ✓	51274387 25842708 26431679 ✓	117359208 36955523 80403685	47222970 17504943 29027
115364741 80195261	67298125 29346861	92057352 42689037	113380936 42556840
64547329 48813139	121961783 90492726	109514632 81268615	125778972 30393060
92971900 62207032	104339409 74835938	60472960 50196521	119811864 34379846
137769153 70176835	144694835 74199225	123822790 40568814	80836465 49178036

Measure the efficiency of the entire school, not the individual ability of the few.

Arithmetic. Test No. 3. Multiplication

Series B Form 1

SCORE 7
No Attempted .....
No. Right 6

You will be given six minutes to work as many of these multiplication examples as possible. You are not expected to be able to do them all. Do your work directly on this paper; use no other. You will be marked for both speed and accuracy, but it is more important to have your answers right than to try a great many examples.

8246 × 29	3597 × 73	5739 × 85	2648 × 46	9537 × 92
74214 16492 239134	10791 25179 262581	28695 45912 487815	15888 10592 121808	19074 85833 877404
4268 × 37	7593 × 640	6428 × 58	8563 × 207	2947 × 63
29886 12804 157926	303720 45558 4859520			
5368 × 95	4792 × 84	7942 × 72	3586 × 36	9742 × 59
6385 × 48	8736 × 502	5942 × 39	6837 × 680	4952 × 47
3876 × 93	9245 × 86	7368 × 74	2594 × 25	6495 × 19

Lesson No._____ Form_____ Date_____

Name_____ Grade_____

9	4	7	8	8	2	6	9	4	5	1	3
3	0	8	6	1	6	7	3	5	3	3	9
6	4	8	5	2	6	7	0	4	9	8	4

4	2	7	6	1	5	3	3	9	4	1	5
7	1	5	0	6	4	8	4	2	0	6	6
4	9	7	9	1	7	9	8	3	3	7	8

8	9	7	8	3	6	3	4	6	8	5	4
8	1	9	9	3	1	9	3	9	6	1	7
7	5	0	8	1	4	9	4	7	0	2	8

8	8	9	5	2	5	7	7	9	4	2	7
2	4	7	1	2	2	5	5	7	8	2	2
9	0	5	8	5	5	8	6	0	8	6	4

9	8	7	0	7	8	6	9	7	9	6	6
5	6	6	3	9	5	1	8	6	7	0	4
9	3	2	5	6	5	4	4	2	6	7	2

1	7	7	7	5	1	6	6	2	8	8	4
4	0	8	4	2	3	7	4	6	0	9	6
6	7	6	5	8	7	9	4	9	5	5	4

1 B

SCORES Tried ___ Right ___

COURTIS STANDARD PRACTICE TESTS

LESSON No. 1 ADDITION

TRIAL No.____ Form B

ORIGINAL

COURTIS STANDARD RESEARCH TESTS

Class Record Sheet

RECORD SHEET
No. 1
Series B

City..... School..... Grade..... Room..... Total Scores .....

Teacher..... Date: 1st Trial..... 2nd Trial..... I. N. F .....

SUMMARY OF CLASS SCORES	Test No. 1 ADDITION			Test No. 2 SUBTRACTION			Test No. 3 MULTIPLICATION			Test No. 4 DIVISION		
	Median			Median			Median			Median		
	Rate or Attempts	Accuracy or Rights	Efficiency	Rate or Attempts	Accuracy or Rights	Efficiency	Rate or Attempts	Accuracy or Rights	Efficiency	Rate or Attempts	Accuracy or Rights	Efficiency
1st Trial												
2nd Trial												
Change												

Test No. 1. Addition. Standard Scores: Grade 3, 4; Gd 4, 6; Gd 5, 8; Gd 6, 10; Gd 7, 11; Gd 8, 12. Accuracy 100%

Score in number of Examples Attempted

Score	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total	%
% 100	—	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		
90	Figures in small type indicate scores in number of examples right.																										
80		—	—	—	—	—	—	—	—	—	9	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		
70		—	—	—	—	4	5	6	7	8	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		
60		—	—	—	—	—	—	5	6	7	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
50		1	—	—	2	—	3	4	4	5	5	6	6–7	7	7	8	9	10	11	12	13	14	15	16	17	18	19		
0 to 49	0	0	0	0–1	0–1	0–2	0–2	0–3	0–3	0–4	0–4	0–5	0–5	0–6	0–6	0–7	0–7	0–8	0–8	0–9	0–9	0–10	0–10	0–11	0–11		
Total																											

Median Scores: *Rate*..... *Accuracy*..... *Efficiency*..... *Standard Scores*.....

Test No. 2. Subtraction. Standard Scores: Grade 3, 5; Gd 4, 7; Gd 5, 9; Gd 6, 11; Gd 7, 12; Gd 8, 13. Accuracy 100%

Score in number of Examples Attempted

Score	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total	%
% 100	—	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		
90	Figures in small type indicate scores in number of examples right.																										
80		—	—	—	—	—	—	—	—	—	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		
70		—	—	—	—	4	5	6	7	8	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
60		—	—	—	—	—	—	5	6	7	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		
50		1	—	—	2	—	3	4	—	5	6	7	8	9	10–11	11	12	13	14	15	16	17	18	19	20	21		
0 to 49	0	0	0	0–1	0–1	0–2	0–2	0–3	0–3	0–4	0–4	0–5	0–5	0–6	0–6	0–7	0–7	0–8	0–8	0–9	0–9	0–10	0–10	0–11	0–11		
Total																											

Median Scores: *Rate*..... *Accuracy*..... *Efficiency*..... *Standard Scores*.....

For instructions, see other side of this page.

Test No. 3. Multiplication. Standard Scores: Grade 4, 6; Gd 5, 8; Gd 6, 9; Gd 7, 10; Gd. 8, 11. Accuracy 100%

Score	Score in number of Examples Attempted																									Total	%
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		
% 100	—	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		
90	Figures in small type indicate scores in number of examples right.		—	—	—	—	—	—	—	—	9	10	11	12	13	14	15	16	17	18	18–19	19–20	20–21	21–22	22–23		
80			—	—	—	4	5	6	7	8	8	9	10	11	12	12–13	13–14	14–15	15–16	16–17	16–17	17–18	18–19	19–20	20–21		
70			—	—	3	—	—	5	6	7	7	8	9	10	10–11	11	12	12–13	13–14	14–15	14–15	15–16	16–17	17–18	17–19		
60			—	2	—	3	4	—	5	6	6	7	8	8–9	8–9	9–10	10–11	11	11–12	12–13	12–13	13–14	14–15	14–16	15–16		
50			1	—	2	—	3	4	4	5	5	6	6–7	7	7	8	8–9	9–10	9–10	10–11	10–11	11–12	11–13	12–13	12–14		
0 to 49	0	0	0	0–1	0–1	0–2	0–2	0–3	0–3	0–4	0–4	0–5	0–5	0–6	0–6	0–7	0–7	0–8	0–8	0–9	0–9	0–10	0–10	0–11	0–11		
Total																											

Median Scores: *Rate*..... *Accuracy*..... *Efficiency*..... *Standard Scores*.....

Test No. 4. Division. Standard Scores: Grade 4, 4; Gd 5, 6; Gd 6, 8; Gd 7, 10; Gd 8, 11. Accuracy 100%

Score	Score in number of Examples Attempted																									Total	%
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		
% 100	—	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		
90	Figures in small type indicate scores in number of examples right.		—	—	—	—	—	—	—	—	9	10	11	12	13	14	15	16	17	18	18–19	19–20	20–21	21–22	22–23		
80			—	—	—	4	5	6	7	8	8	9	10	11	12	12–13	13–14	14–15	15–16	16–17	16–17	17–18	18–19	19–20	20–21		
70			—	—	3	—	—	5	6	7	7	8	9	10	10–11	11	12	12–13	13–14	14–15	14–15	15–16	16–17	17–18	17–19		
60			—	2	—	3	4	—	5	6	6	7	8	8–9	8–9	9–10	10–11	11	11–12	12–13	12–13	13–14	14–15	14–16	15–16		
50			1	—	2	—	3	4	4	5	5	6	6–7	7	7	8	8–9	9–10	9–10	10–11	10–11	11–12	11–13	12–13	12–14		
0 to 49	0	0	0	0–1	0–1	0–2	0–2	0–3	0–3	0–4	0–4	0–5	0–5	0–6	0–6	0–7	0–7	0–8	0–8	0–9	0–9	0–10	0–10	0–11	0–11		
Total																											

Median Scores: *Rate*..... *Accuracy*..... *Efficiency*..... *Standard Scores*.....

Instructions for Recording Scores.

For each test separately, sort the papers from one class on the basis of the scores in number of examples attempted. (For instance, put into one pile all those papers having a score of 12 examples attempted, into another pile all the 10,'s into another all the 9's and so on.) Then, one pile at a time, resort the papers in each of these piles on the basis of their scores in number of examples right. (For instance, if there were six papers each having a score of twelve examples attempted, these would be sorted into piles of twelve right, eleven right, and so on.) Next, count the number of papers in each of these piles and record the numbers in the proper vertical column of the table. (That is, if there was one paper with a score of 12 attempted and 12 right, two papers with a score of 12 attempted and 11 right, and three papers with a score of 12 attempted and 9 right, a figure 1 would be written in the column headed 12, and in the division containing the small figure 12; a figure 2 in the division containing 11, and 3 in the division containing 9.) When all the scores have been entered, find the sum of the figures in each vertical column and in each horizontal row. If the work has been accurately done, the sum of the horizontal totals will just equal the sum of the vertical totals.

Directions for making the proper computations from these records are given in Folder D.

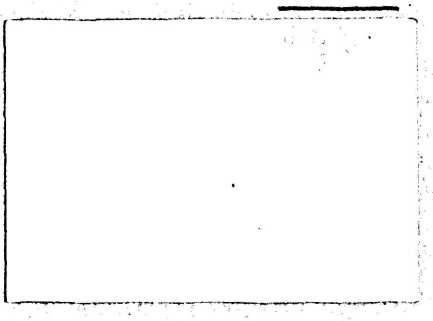
No. 33 *Multiplication*

STUDEBAKER ECONOMY PRACTICE EXERCISES IN ARITHMETIC

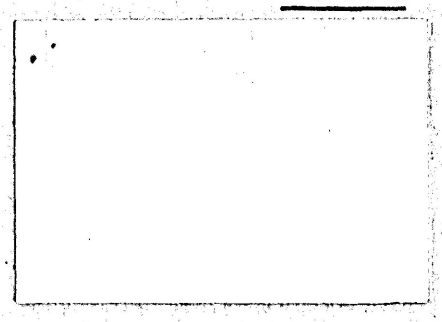
Set B

(Patented Oct. 19, 1915)

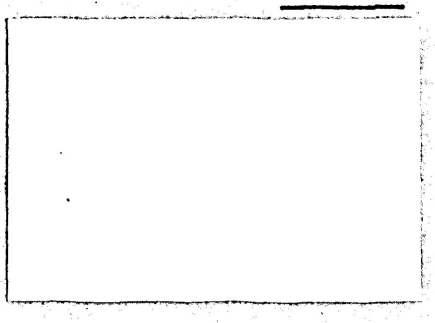
$$\begin{array}{r} 68471 \\ \times\ 5832 \\ \hline \end{array}$$



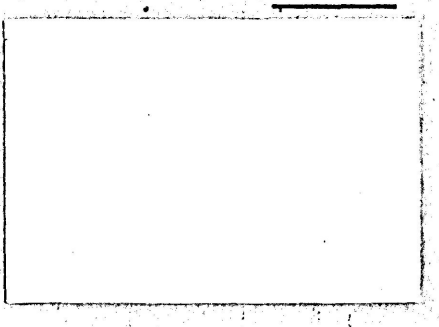
$$\begin{array}{r} 52093 \\ \times\ 7496 \\ \hline \end{array}$$



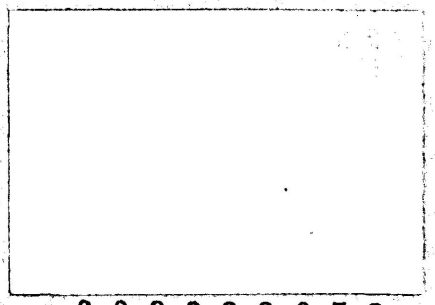
$$\begin{array}{r} 73156 \\ \times\ 6874 \\ \hline \end{array}$$



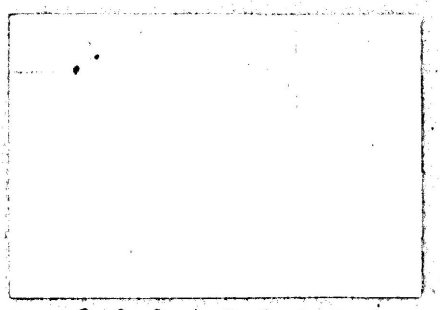
$$\begin{array}{r} 94830 \\ \times\ 95 \\ \hline \end{array}$$



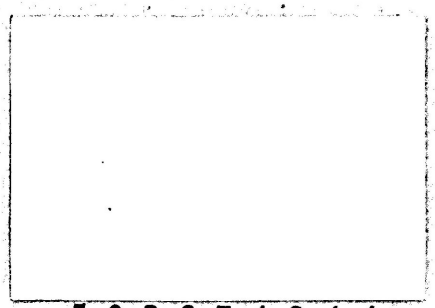
SCOTT, FORESMAN AND COMPANY
CHICAGO NEW YORK



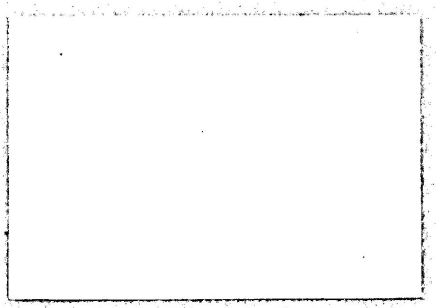
3 9 9 3 2 2 8 7 2



3 9 0 4 8 9 1 2 8



5 0 2 8 7 4 3 4 4



9 0 0 8 8 5 0

B I B L I O G R A P H Y

1. See copy of Courtis Test Series B- in appendix.

2. See sample of Studebaker Practice Material in appendix.

3. See sample of Courtis Practice material in appendix.

4. "Class" in this investigation means the A or B division of a grade. White children only, that had taken both tests.

5. The sections were chosen at random with no regard for the original ability of the group.

6. Uhl, W. J. "The Use of Standardized Materials in Arithmetic for Diagnosing Pupils' Methods of Work"; in Elementary School Journal, Nov. 1917.

7. Brown, J. C. An Investigation on the Value of Drill Work in the Fundamental Operations of Arithmetic; in Journal of Educational Psychology, Vol 2., Feb. 1911, p.81-88; Vol.3, Nov. 1912, p.485-492 and Dec. 1912, p.561-570.

8. Childs, H.G. "A Half Years Progress in the Achievement of One School System (as measured by the Courtis Tests.), 15th Year Book, National Society of Education. Part I, p.83-90.

9. See copy of Courtis Standard Record Sheet in appendix.

INDEX OF TABLES

	Page
Courtis 5th Grade Medians	32
" 6th " "	47
" 7th " "	61
" 8th " "	75
Dictated Drill 4th Grade Medians	19
" " 5" " "	32
" " 6" " "	47
" " 7" " "	61
" " 8" " "	75
Studebaker 4th Grade Medians	19
" 5" " "	32
" 6" " "	47
" 7" " "	61
" 8" " "	75

INDEX OF GRAPHS

	Page
Courtis 1917 Medians for Lawrence Children	1, 2, 3
Courtis 5th Grade Medians	33, 37
" 6th " "	48, 50
" 7th " "	62, 65
" 8th " "	76, 79
" Per cent of Gain or Regression in 20 days	25, 26, 41, 42 54, 55, 69, 70 83, 84.
Dictated Drill 4th Grade Medians	21, 23
" " 5th " "	35, 38
" " 6th " "	49, 52
" " 7th " "	64, 67
" " 8th " "	78, 81
" " Per cent of Gain or Regression in 20 days.	25, 26, 41, 42, 54, 55, 69, 70 83, 84.
Studebaker 4th Grade Medians	20, 22
" 5th " "	34
" 6th " "	51
" 7th " "	63, 66
" 8th " "	77, 80
" Per cent of Gain or Regression in 20 days	25, 26, 41, 42, 54 55, 69, 70, 83, 84.